INVESTIGATION OF CONTEMPORARY PROBLEMS AND PRACTICES IN POST-HURRICANE RECONSTRUCTION IN THE COMMERCIAL SECTOR OF THE SOUTHEAST REGION OF THE UNITED STATES

A Thesis

by

SUCHAYITA BHATTACHARJEE

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2008

Major Subject: Construction Management

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Approved by:

Co-Chairs of Committee,	Charles Graham
	Sarel Lavy
Committee Members,	James Smith
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ABSTRACT

Investigation of Contemporary Problems and Practices in Post-hurricane Reconstruction in the Commercial Sector of the Southeast Region of the United States.

(December 2008)

Suchayita Bhattacharjee, B.E., Mumbai University

Co-Chairs of Advisory Committee: Dr. Charles W. Graham
Dr. Sarel Lavy

The thesis addresses the problems faced by contractors during the recovery and rebuilding process after hurricanes that struck the southeast region of the United States in 2004-2005 hurricane seasons. It also deals with the practices they normally use to solve such problems. First, through literature review, six possible problems were identified, which were then used to gather information about the major problems faced by the construction industry in post-hurricane projects. The possible problems were site logistics, material transportation, labor, political influences, building permits and site location. Data were then collected via surveys of 450 contractors involved in post-hurricane construction in Alabama, Florida, Louisiana, Mississippi, North Carolina, South Carolina and Texas.

The analysis showed that three of those problems - site logistics, labor and material transportation were identified as major problems among the respondents. The remaining were considered as problems, but not major ones in post-hurricane reconstruction projects. The study recommends practices, such as better planning, scheduling, coordination, supply chain management and use of experienced site personnel, for

tackling the problems of site logistics and material transportation. Outsourcing labor was one of the methods suggested to improving conditions with regards to labor problems. The research identifies the problems and provides a list of possible solutions to these problems, as used by the contractors of such projects. Therefore, by using the suggested practices, post-hurricane reconstruction projects can be beneficial for contractors, and the outlook towards these projects as being less profitable can be changed.

DEDICATION

To my parents….for their patience and support

ACKNOWLEDGEMENTS

I would like to express my gratitude to all those who made completing this thesis possible. I would like to thank my committee co-chairs Dr. Charles W. Graham and Dr. Sarel Lavy, for their guidance and support throughout the course of this research. I also thank Dr. James Smith and Dr. Ivan Damnjanovic for their helpful and valuable criticism on the research and thesis draft.

I would also like to thank Mr. George Eustace from the Department of Construction Science for helping me out with the survey population and Dr. Walter G. Peacock from the Department of Landscape Architecture and Urban Planning for his guidance regarding the scope of this thesis. I would also like to give my heartiest thanks to Mrs. Amy Campbell of International Facility Management Association (IFMA), for her help during the data collection phase of my research project. I would also like to thank Srikant Bondugula who helped me out with MATLAB, as it was a new application I learned during the research.

Finally, I would like to thank my friends Priyanka and Mandar for their continuous support and tolerance during my mood swings as the sleepless nights went by. With your encouragement, anything impossible seems possible…and I am proud to have you all around me.

NOMENCLATURE

AL	Alabama
FL	Florida
LA	Louisiana
MS	Mississippi
NC	North Carolina
SC	South Carolina
TX	Texas
SSHS	Saffir/Simpson Hurricane Scale
IDIQ	Indefinite Delivery Indefinite Quantity
BIM	Building Information Modeling
JIT	Just-In-Time
SCM	Supply Chain Management
PM	Project Manager
CEOs	Chief Executive Officers
PE	Project Engineer
FEMA	Federal Emergency Management Agency
NHC	National Hurricane Center

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INTRODUCTION

Background

The 2004 and 2005 hurricane seasons produced eight out of the ten costliest systems ever to affect southeastern United States (Blake et al. 2007).They are shown in Table 1. In the aftermath of a hurricane, the entire community (Guston 2002) desires to get back to "business as usual", and though everyone makes an effort to work towards that direction, it is not easily possible due to numerous problems faced, such as physical constraints, coordination constraints, utility constraints and uncertainty constraints (Kritzek et al. 1996).

Table 1. The ten costliest mainland United States tropical cyclones, 1900-2006 (Blake et al. 2007)

RANK	HURRICANE	YEAR	CATEGORY	DAMAGE(in $US millions)
1	Katrina	2005	3	81,000
2	Andrew	1992	5	26,500
3	Wilma	2005	3	20,600
4	Charley	2004	4	15,000
5	Ivan	2004	3	14,200
6	Rita	2005	3	10,000
7	Frances	2004	2	8,900
8	Hugo	1989	4	7,000
9	Jeanne	2004	3	6,900
10	Allison	2004	3	5,000

This thesis follows the style of the *Journal of Construction Engineering and Management.*

The construction industry is instrumental in bringing about such a change through a process of recovery and reconstruction projects. Reconstruction projects are challenged by high risk and urgency (Attalla et al. 2003). So, it is necessary to understand the practices that can overcome these challenges, and make it a profitable venture. The critical success factors on retrofit projects are experienced and cohesive project team, contract incentives, partnering arrangements, special procurement, preplanning strategies and a high level of management support (Sanvido and Riggs 1991). This research is a study of the contemporary practices associated with post-hurricane reconstruction projects in the southeast region of the United States. The research investigates the practices followed by contractors who provide restoration and reconstruction services to clients in the commercial construction sector. It explores the difficulties faced by contractors during the process of post-hurricane reconstruction, and current practices used by these contractors.

Problem statement

The purpose of this research is to identify the contemporary problems and practices that are implemented to overcome obstacles in commercial, post-hurricane reconstruction projects in the southeastern region of the U.S.A.

Subproblems

The following subproblems are addressed in the research:

- To study the hurricanes that caused damage to the southeast region of U.S.A. through a literature review;

- To identify the contractors involved in post-hurricane construction from the lists of general contractors and specialty contractors;
- To create a survey for data collection regarding the problems faced and practices used by commercial contractors, and analyze obtained data; and,
- To recommend practices in post-hurricane reconstruction based on the above findings.

Research objectives

The research objectives of this study are:

- To identify and categorize the most common problems faced by contractors in construction projects in hurricane affected areas;
- To determine if all contractors perceive the identified common problems as major problems;
- To identify the practices used by contractors to overcome the common problems; and,
- To analyze the practices used and recommend practice to solve the major problems.

Definitions

The following definitions are used in the study:

<u>Reconstruction</u>

This study defines reconstruction projects as a category that includes the modification, conversion, or phased replacement of an existing facility in hurricane affected areas (Attalla et al. 2003).

Commercial construction

As per the 2007 North American Industry Classification System (NAICS 2007) definition, commercial construction “comprises establishments primarily responsible for the construction (including new work, additions, alterations, maintenance, and repairs) of commercial and institutional buildings and related structures, such as stadiums, grain elevators, and indoor swimming facilities. This industry includes establishments responsible for the on-site assembly of modular or prefabricated commercial and institutional buildings. Included in this industry are commercial and institutional building general contractors, commercial and institutional building operative builders, commercial and institutional building design-build firms, and commercial and institutional building project construction management firms.” This definition of commercial construction is used for the purpose of this study.

SSHS (Saffir Simpson Hurricane Scale)

The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane’s present intensity, with 1 being the least damage to 5 representing catastrophic damage. Estimates of the potential property damage and flooding possible along the coastline during a hurricane landfall are given by this scale. Refer Appendix A for the scale.

Delimitations

The study was delimited to the following:

- The study involves contractors in the commercial construction sector. These contractors were classified into three categories based on the type of projects they do (Ramsey 2007). However, the dollar amount of projects was decided based on the size of projects information given by them for their company in The Blue Book website (2008). They are as follows:

1. Small: Less than $10 million
2. Medium: Between $10 to $50 million
3. Large: More than $50 million

This classification helps to study how the size of contractors is related to perception of a problem as a major problem. After conducting the pre-tests on the survey, the study was delimited by classifying the contractors to the above three categories.

- Only the southeastern region of the U.S.A, comprising the states of Alabama, Florida, Louisiana, Mississippi, North Carolina, South Carolina, and Texas, was considered for the study because these areas were the most affected by the hurricanes during the study period 2004-05.
- Data regarding problems faced by contractors and prevalent practices to handle them was collected for hurricanes in the period of two years from 2004 to 2005. They are: Hurricane Katrina on August 23rd, 2005, Hurricane Rita on September 24th, 2005, Hurricane Wilma on October 23rd, 2005, Hurricane Charley on August 13th, 2004, and Hurricane Ivan on September 9th, 2004. These hurricanes have caused the maximum damage financially, especially in the southeast region of the U.S.A.

LITERATURE REVIEW

Introduction

Many publications mention how each year thousands of people are killed and many more are made homeless because of natural disasters (Johnson et al. 2006; Peacock et al. 2005; Haas et al. 1977). Recovery through reconstruction projects after such disasters is a step to getting back to normalcy. Studying reconstruction projects is in particular important because large investments are being directed to these projects and the performance of reconstruction projects is much lower than new construction when considered with respect to time, cost and quality (Attalla 1996; McKim et. al. 2000). The literature review shall explain the different problems faced by contractors after the occurrence of a hurricane.

Review of existing literature on post-hurricane reconstruction

Research has been done by McKim et al. (2000) to analyze and compare the performance of new construction versus reconstruction projects. Attalla et al. (2003) studied how information was obtained on the reasons behind cost overruns and poor quality for fifty reconstruction projects by surveying construction professionals. However, these were researched only on reconstruction projects; and not on post-hurricane reconstruction projects.

Hurricanes and their aftermath

Based on the tropical cyclone reports published for hurricanes, the years 2004 and 2005 were subjected to many hurricanes leaving a trail of destruction and grievances.

The problems due to the damages caused by hurricanes have to be solved by an interdisciplinary approach because apart from physical damage, there are psychological barriers that also have to be overcome as a part of the recovery process (Peacock et al. 2005). Based on tropical cyclone reports from the National Hurricane Center, Table 2 summarizes the hurricanes and their consequences concerning death tolls and extent of damage. The extent of damage is defined as the SSHS scale (Appendix A) based on the type of hurricane. Direct deaths indicate those caused by winds, tornadoes, storm surge or oceanic effects of the hurricane. Indirect deaths are those caused by hurricane-related incidents such as car accidents, crime, fire and health issues like poisoning, or lack of emergency aid. Indirect deaths could also be due to mental trauma of losing relatives, family and friends.

Table 2. Description of hurricanes

Sr.No.	Hurricanes	Date	SSHS	Regions Struck	Damage
1	Charley	9-14 Aug 2004	4	FL,NC,SC	Extreme
2	Ivan	2-24 Sept 2004	3	AL,LA,TX	Extensive
3	Katrina	23-30 Aug 2005	3	LA,MS,AL,FL	Extensive
4	Rita	18-26 Sept 2005	3	FL	Extensive
5	Wilma	15-25 Oct 2005	3	FL	Extensive

Hurricane Charley

Hurricane Charley began as a tropical depression formed just north of Trinidad and Tobago and made landfall along the west coast of Florida at Cayo Costa on Friday

August 13th, 2004. It was the strongest hurricane to hit the U.S. since Andrew in 1992. Even though it was small in size, there was serious damage in Charlotte County due to very strong winds. Even within the Florida Peninsula, extensive damage was observed. According to the National Hurricane Center's Tropical Cyclone Report for Hurricane Charley (2004), the insured damages were estimated as $6.755 billion in Florida, $25 million in North Carolina and $20 million in South Carolina, totaling to $6.8 billion. Also, the Insurance Information Institute (2008) claimed that insured losses amounted to $7.4 billion. To calculate the total loss, doubling the insured losses gives a rough preliminary estimate of $15 billion. The direct death toll was 15, while the indirect deaths caused by Charley were 20 (Pasch et al. 2004).

Hurricane Ivan

According to Stewart (2004), Hurricane Ivan was a Cape Verde type of hurricane that reached Category 5 strength thrice on the Saffir Simpson Hurricane Scale (SSHS). Cape Verde type hurricanes develop near the Cape Verde islands off the west coast of Africa, hence the name. According to the National Hurricane Center's Tropical Cyclone Report for Hurricane Ivan (2004), there were 25 deaths in the U.S., of which 14 were in Florida, 8 in North Carolina, 1 in Mississippi and 2 in Georgia. The causes of death were tornadoes (7), storm surge (5), fresh water floods (4), mud slides (4), wind (3), and surf (2), where the indirect number of deaths due to Ivan tolled to 32 (Stewart 2004)..The insured losses were $7.11 billion. $4 billion of that occurred in Florida. Damage occurred to homes, buildings and other structures which resulted in colossal losses. Severe damage to numerous beachfront homes, apartment & condominium buildings was witnessed due to excessive beach erosion. Scouring of sand occurred from underneath building foundations due to inundating wave action causing buildings to collapse. In Florida, the areas of Baldwin, Escambia and Santa Rosa were affected badly. The hurricane resulted in three quarter of a mile long and seventy feet high debris pile (Stewart 2004).

Hurricane Katrina

Hurricane Katrina was one of the five deadliest hurricanes to ever strike the United States. It was a Category 1 hurricane of SSHS in Florida and then it strengthened to Category 5 over the Gulf of Mexico. The total number of fatalities related to Katrina was 1,833 split as follows:

Table 3. Deaths due to hurricanes
(Knabb et al., 2005b)

State	Total deaths	Direct deaths
Louisiana	1,577	1,300
Mississippi	238	200
Florida	14	6
Georgia	2	1
Alabama	2	-

Katrina's economic and environmental ramifications were widespread and long lasting. As shown in Table 3, the total number of deaths due to Hurricane Katrina was high. Katrina's insured losses were estimated to be a sum of $40.6 billion (Knabb et al.

2005b). The total damage is being estimated around $81 Billion if assumed roughly twice the insured losses.

Hurricane Rita

Hurricane Rita reached the US near Sabine Pass, Texas on September 24, 2005, as a Category 3 storm. It resulted in coastal changes along the Gulf Coast. Rita produced storm surges devastating different communities along Louisiana's coast. The winds, rain and tornadoes caused a large number of fatalities and damages from Texas to Alabama. Storm surges caused floods in portion of Florida Keys. Since over 3 million residents were evacuated in Texas and Louisiana, the number of people at risk from the storm surge and wind related damage were significantly reduced (Knabb et al. 2005a). However, there was extensive flooding along the coastal region of Texas and Louisiana as a result of Rita's September 24 landfall. Louisiana parishes such as Cameron, Jefferson, Davis, Terrebonne and Vermilion were flooded by a storm surge of around 15 feet, trapping a few of their residents. Also, due to Rita, 2 refineries in Port Arthur, TX were damaged though the storm missed the larger oil-refining region near Houston and Galveston. The estimate of Rita's insured cost is around $4-5 billion which is comparatively less than Hurricane Katrina and Hurricane Andrew. Assuming the uninsured losses to be twice the insured losses, the total monetary damage was about $10 billion. There were around 55 indirect fatalities in Texas (Knabb et al. 2005a).

Hurricane Wilma

On 24th October 2005, Hurricane Wilma caused extensive damage over Southern Florida, including disruption of electrical services. The total insured damage was estimated to be at \$10.3 billion (Pasch et al. 2005). Doubling the insured losses to get an estimate of the total damage equates it to approximately \$20.6 billion. This is supposed to be the third costliest hurricane after Katrina and Andrew. After Hurricane Wilma, broken windows and extensive roof damage and destroyed mobile homes were a very common site (Pasch et al. 2005).

Role played by contractors in rebuilding and recovery

The hurricanes discussed above are a grim reminder of the vulnerability of the United States to hurricanes. This has prompted recovery and rebuilding work in the southeast region of the United States. For Katrina alone, the Federal Government has provided more than \$110 billion in resources (The White House 2006). The funding is useful to cover expenses such as relocation, rental assistance, infrastructure repair, flood insurance payments, education and debris removal. Nearly \$6 billion has been allotted for the Army Corp of Engineers to improve the levees, make the entire hurricane protection system better and stronger by the year 2010 (The White House 2006). After the advent of Hurricane Katrina, 103 million cubic yards of debris have been removed from Alabama, Texas, Mississippi and Louisiana (The White House 2006). There have been loans to business owners that have been approved by the U.S. Small Business Administration (SBA) in the Gulf Coast States affected by the hurricanes, where more than 22,000 loans were disbursed to small business owners summing to \$2.4 billion (The White House 2006). Therefore, there were a lot of opportunities for the construction industry to rehabilitate the hurricane affected communities.

Since loans were disseminated among the economy to drive it back to normalcy faster, construction of such commercial buildings could be foreseen. The construction industry contributed to the rebuilding process in various sectors such as residential, commercial, infrastructure and industrial (Gould and Joyce 2009). Due to damages caused by hurricanes, the local contractors in the hurricane affected areas experience a large number of new job openings. However, there have been situations where work has been awarded to out-of-state contractors. This has caused dissatisfaction among local contractors (Gunewardena and Schuller 2008). Such kinds of problems are being faced by local contractors at various levels of the construction process, such as during the planning, execution and completion.

Slow progress of rebuilding work

Considering the case of Hurricane Katrina (Gunewardena and Schuller 2008), there was a drastic change in employment following the hurricane. For example, in St. Bernard Parish, Louisiana, employment reduced 40 percent in September 2005 from September 2004 (Monthly Labor Review and Kosanovich 2006). Similarly, in Jefferson and Orleans parishes, the employment fell by 25 percent. The unemployment rate for Louisiana after Hurricane Katrina increased to 12.1 percent (Gunewardena and Schuller 2008). Due to political pressure, the 1931 Davis-Bacon Act was lifted on September 8, 2005 by President Bush. This act required federal contactors to pay at least the average regional wage. In a chain of events, the Department of Homeland Security temporarily suspended the requirement of employers to require employees to prove their U.S. citizenship (Gunewardena and Schuller 2008). Thereafter, the Department of Labor lifted federal wage restrictions for sixty days. Moreover, Occupational Safety and Health Administration suspended the enforcement of job safety and health standards in hurricane-afflicted counties (Gunewardena and Schuller 2008). Though, these different regulations were lapsed for a few weeks, they were soon changed to the original ones. However, this lapse period was enough for displacing local citizens and evacuees from having a preferred status in gaining reconstruction jobs, and thereby depriving them of resuming the role of actors rather than disaster victims, as well as making them dependent on external aid for assistance (Gunewardena and Schuller 2008). According to the Stafford Act provisions, preferential treatment should be given to local workers after a disaster; however, this act has a loophole that states that "to the extent feasible and possible". However, many a times legislative decisions backfire, and this was visible in the situation developed during Katrina. The entire scenario after a hurricane seems highly uncertain since there are legislative decisions and federal regulations that undergo changes. This reduces the effectiveness of the recovery process. This aspect shows how a post-hurricane reconstruction project differs from those in a normal scenario.

Problems faced by contractors

Different problems are faced by contractors after a hurricane strikes a particular region. According to a study of causes in construction projects by Baldwin and Manthei (1971), the different factors that contribute to delays in construction projects in the U.S. are weather, labor supply, subcontractors, design changes and shop drawings, foundation conditions, material shortage, manufactured items, sample approvals, jurisdictional disputes, equipment failure, contracts, construction mistakes, inspections, finances, permits and building codes. The grim situation caused by hurricanes is similar to the construction industry in previous years like 1971. By their nature, reconstruction projects have characteristics that are different from those encountered in the construction of a new facility.

Freeman (2004) discusses about allocation of post-disaster reconstruction financing to housing and how the World Bank earmarks some finances for the reconstruction of housing. This could also mitigate the monetary problems faced by the contractors.

Attalla and Hegazy (2003) studied the reasons for poor performance in reconstruction projects, and identified the problems faced in reconstruction projects. The problems they identified include unforeseen existing site conditions, scope change by owner, design change (upgrade), schedule problems, design coordination, regulatory requirements, and poor performance by contractors. These problems have been slightly modified to get the list relevant to post-hurricane reconstruction projects. The question related to ranking helps us to understand the perception of contractors towards these problems in relation to each other when in a post-hurricane reconstruction project. These problems are different than the ones that have been obtained from literature review. This is because in the study done by Attalla et al. (2003), they are mentioned as problems in reconstruction projects, while the problems in the literature review focus mainly on those faced by contractors.

Rasmussen (1997) mentioned in his case study titled “The Rebirth of a Station” that unforeseen existing site conditions and the absence of as-built drawings were major challenges since they had to continue the renovation process of the railway station while serving 500,000 travelers a day. Another case study recommended the use of the Critical Path Method (CPM) as an adequate schedule control method along with a strong need for an effective project management system and continuous communication between all parties, and contract documents that enable the project team to deal with uncertainties and changes (Kritzek et al. 1996).

Problems

From literature review, each problem will be considered and explained in detail below.

1. Site logistics

A site logistics plan must be established based on a review of the plans and the project site to delineate some of the issues such as on-site storage of equipment, laydown and staging areas, space for cranes, truck turnaround areas, construction trailer areas, and waiting areas for concrete trucks. This plan should be implemented on the day of mobilization, and followed by the field personnel throughout the project (Atallah 2006).

2. Material transportation

The suppliers manufacture, fabricate, install materials and building components. Different trade organization such as the American Concrete Institute, the American Plywood Association and the National Electrical Manufacturers Association develop criteria to establish a level of quality for different materials. These are then adopted by other groups, such as the American National Standards Institute (ANSI), which are often incorporated into architectural specifications, government regulations and building codes (Gould and Joyce 2009). According to Frimpong and Oluwoye (2003), material procurement is a problem of the construction industry. Storm damage caused indirect problems such as higher gas prices, displacement of people who cross state lines in search of jobs and shelter as also crippled communications.

A sharp increase in demand for building materials in the wake of the four hurricanes, combined with record new home construction across the Unites States, had created spot shortages for items such as cement, bricks, roofing tiles and lumber.

3. Labor supply

Due to displacement of people and destruction of property, labor problems arose because labor could not find housing, while they would go to work. Workers employed by contractors would have to stay in broken trailers and damaged houses. Between August 2005 and October 2005, construction lost jobs by 26,500 which were fourth among other industries. According to Faridi and El-Sayegh (2006), skilled labor shortage, shortage and skill of manpower are a major problem with regards to labor. Sambasivan and Soon (2007) also cited labor supply as a major problem in the construction industry.

The impact of a disaster such as a hurricane on labor markets is marked, sometimes limiting the supply of jobs because of economic dislocation and limiting the supply of labor because of displacement. For example, after Hurricane Katrina, there was a major population displacement and structural damage which severely reduced employment over the following year (Gunewardena and Schuller 2008). In New Orleans, African American residents began alleging that contractors were biased toward hiring Latino workers over black people (Gunewardena and Schuller 2008). Thus, contractors were faced with a problem in regards to availability and hiring labor.

4. Getting building permits

After a hurricane, uncertainty prevails in the region because of expected changes in policies and legislations. According to Haas et al. (1977), if a city is to become safer after a disaster, building codes are a major consideration. Hurricanes cause floods. These floods could cause changes in land use. There is a domino effect due to changes in land use, which cause people to move into other land and buildings, and possibly increase urban sprawl.

5. Political influences in the hurricane affected areas

According to Horowitz (1978), even in normal conditions, policies and their implementations are constrained by elements of the social context like political pressures, demands of special interest groups, and economic conditions prevalent at that point of time. Every group has divergent images of the urban environment resulting from class origins, ethnicity, and other differentiating factors.

6. Site location

Projects have neighbors who might be in favor or not with the idea of a new facility in the community. Low-income and minority household and neighborhoods generally suffer a decline in their socioeconomic status and become vulnerable (Peacock et al. 1997). If the construction sites are in poor economic regions, there is always a threat to security of materials, equipment and labor. For these purposes, the problem of site location needs to be considered.

<u>Importance of the type of project delivery system</u>

During the execution of post-hurricane projects, many contracts of different sizes are awarded to contractors. This process of assigning the contractual responsibilities of a project's design and construction is known as a "project delivery system" (Project Delivery Systems for Construction 2004). The type of project delivery system is important as one of the components for the success of the project as it helps explain to all participants the goals and objectives, and how all parties are related to each other contractually. The delivery method's success or failure is totally dependent on the performance, trust and cooperation among the parties. The following methods may be explained as follows:

- Design-Bid-Build

  Here, design and construction are separate contracts and the only criterion for final selection is the least total construction cost.

- CM-at-Risk

  Design and construction are separate contracts but, the criterion for final selection is not only the least total construction cost.

- Design-Build

  In this type of contracting, design and construction contracts are combined.

- Job Order Contracting (JOC)

  Job Order Contracting (JOC) is used by owners for projects that require accelerated procurements. They also include small, time-sensitive projects, and projects that have a difficult to define scope. They are also known as on-call contracts. The Army

Corp of Engineers describes IDIQ (Indefinite Delivery Indefinite Quantity) as contracts used for service contracts and Architect-Engineering (A-E) services. The Army Corp of Engineers decides to award the contract for base years and option years. There are main clauses and special contract requirements in the base contract for the entire contract. The established base contract has services that are placed as orders and they use the clauses and special contract requirements in the base contract, other than in exceptional cases wherein they might encounter huge amount of losses by use of the base contract.

Conclusions

The literature review shows that there are a series of events that follow a hurricane. The rebuilding and recovery process is often slow to implement due to numerous reasons as there are barriers faced by contractors which need to be studied. It teaches us that there are barriers faced by contractors; these difficulties need to be studied. This study presents the major problems, as well as current practices that the contractors use while facing problems on post-hurricane reconstruction projects. Having this knowledge helps improve productivity and profit potential on such projects. It also increases the opportunity to do more projects in a shorter span. The chronological order of the events following a hurricane as perceived from the literature review can be described as shown in Figure 1.

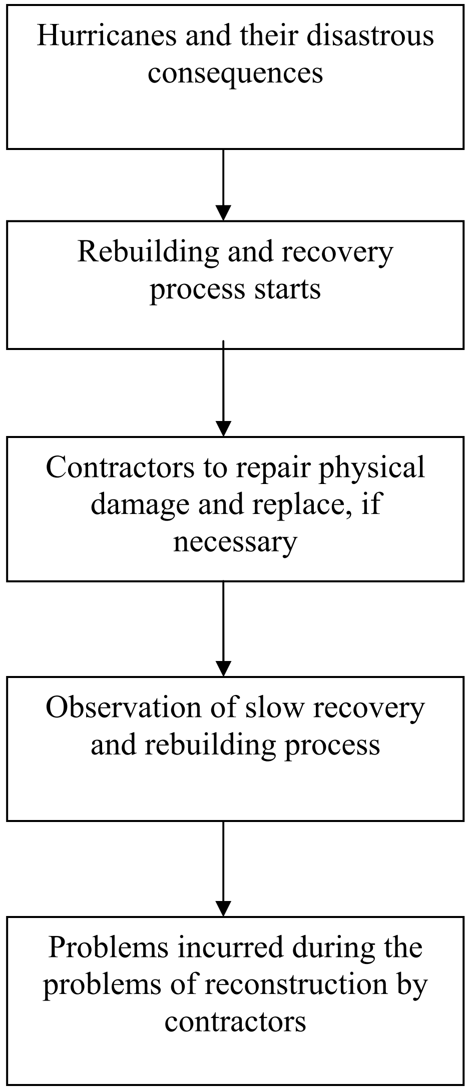


Figure 1. Chronological order of events after a hurricane

Thesis organization

The research objectives described previously form the outline for this research. The first part of the study was a literature review of books, journals, periodicals, and World Wide Web sources related to hurricanes, rebuilding and construction thereafter. The second part of the study will comprise of a survey among commercial contractors in the southeast region of the United States. The list of the companies will be obtained from the Blue Book of Building and Construction, Associated General Contractor listing and Associated Builders and Constructors listing in Texas. The questions in the survey will be formulated on the basis of the literature review. The secondary source for data of about the problems and the current practices will come from FEMA reports, NHC releases, public releases and annual reports of different Non-Governmental Organizations associated with recovery work. The data from all the different participants in the survey will be analyzed to identify qualitative characteristics with the areas of inquiry. The findings will be then be subjected to statistical analysis to identify trends. From the statistical analysis, inferences will be made about the current problems and practices construction companies in the southeast region of the United States.

RESEARCH METHODOLOGY

Introduction

Three main techniques are generally used to collect primary data such as survey research, direct measurement, and observation (Rea and Parker 2005). Secondary research is a fourth way of data collection. In this research, the technique of secondary research is used as a complement to the survey research process. The secondary research helps to prepare the survey research instrument, so it would be explained first, and thereafter the survey methodology.

Johnson (2001) uses the term “survey research” to refer to almost any form of descriptive, quantitative research. However, the process of survey research consists of collecting information about one or more groups of people about their characteristics, opinions, attitudes or previous experiences by questioning them and tabulating their answers. The final goal is to learn about a large population by surveying sample of that population, also known as descriptive or normative survey.

Through the survey research process, opinions are obtained with defined and determinable reliability. Surveys are generally simple in design. There are a series of questions asked to participants, and then their responses are summarized with percentages, frequency counts and other statistical indexes (Leedy and Ormrod 2005). Based on the responses from the sample, inferences can be drawn about the population. This type of research captures a fleeting moment in time.

According to Rea and Parker (2005), some of the different stages in survey research are as follows:

1. Identifying focus of the study and method of research, determining the research schedule and budget;
2. Establishing an information base;
3. Determining the sample frame, sample size and sample selection;
4. Designing the survey instrument and pre-testing it;
5. Implementing the survey;
6. Coding the completed questionnaires and computerizing the data; and,
7. Analyzing the data and preparing the final report.

Selection of method

Use of survey methodology was suggested based on the research objectives, number of contractor firms available, and the fact that data is spread out in a vast sample. Since descriptive research investigates a situation without changing or modifying the situation under study, this study could fall under this category. Figure 2 below explains how the survey process helps to obtain data and the stages through which the process takes place.

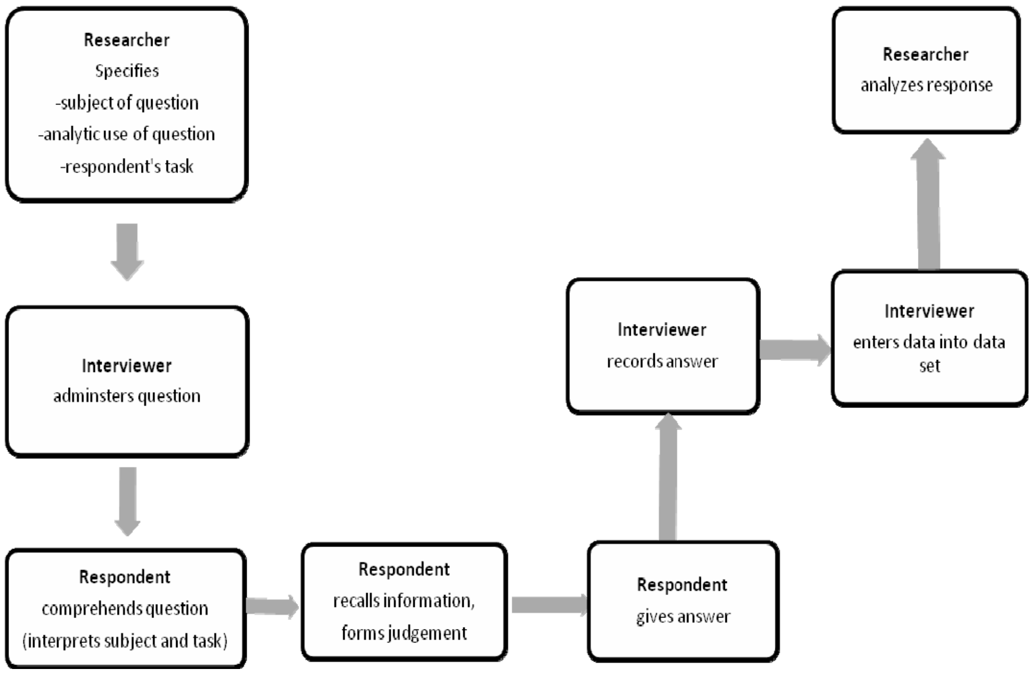


Figure 2. Model of survey data collection
(Source : Czaja and Blair 2005)

Studies were done to examine existing sources of data as a first step in the research process to take advantage of information that may have already been collected. This will enable to shed light on the study. Secondary information can be found in libraries and websites of government organizations and private foundations. The information obtained from such sources helps to create the knowledge base needed to put forth the survey questionnaires. It also gives more insight to issues found in the literature review. This particular section is also known as the information base.

Population of study

Four hundred and fifty contractors involved in reconstruction projects were identified for the study. The survey was administered to participants in commercial construction firms. To sample this population, online websites like the Associated General Contractors of America's website and The Blue Book were consulted. The Department of Construction Science at Texas A&M University has a list of companies associated with its Construction Industry Advisory Council. This list was also used to get the contact information of some of the contractors. Surveys were sent out to a total of 450 contractors in the following seven states: Texas, Florida, Alabama, Mississippi, Louisiana, North Carolina, and South Carolina.

<u>Sample size</u>

To determine the number of questionnaires to be sent, the sample size was calculated using the following formula (Montgomery and Runger 2003):

$$n = \left(\frac{Z_{\alpha/2}}{E} \right)^2 p(1-p) \tag{1}$$

where: n = the number of respondents;

$Z_{\alpha/2}$ = values for a particular level of confidence coefficient;

E = variability or bound error;

p = proportion of contractors actually facing problems in post-hurricane reconstruction.

As a conservative approach, p =50% is considered to be an acceptable value. Using E =10% and a confidence value of 80%, Z=1.28 since we are having a confidence level of 80%. Substituting these values into the formula, gives us a number of responses (n) that are needed. Here, n = 41.

Rate of response

For similar surveys conducted among contractors, the expected rate of response of the survey was about 25-30% (Arditi and Chotibhongs 2005; Vidogah and Ndekugri 1997; Cox et al. 2003). When enough responses were not received via emails, follow-up phone calls were made (Dillman 2000). Assuming a conservative rate of response of only 10%, a sample of four hundred and fifty was used.

Preparation of questionnaire

The questionnaire was formulated based on a literature review. The literature review identified the problems to be considered in this study as relevant to a post-hurricane scenario. The questionnaire began with a few screening questions. Related questions were placed together within the questionnaire so that the respondent can focus and concentrate on specific issues without distraction. Table 4 describes the format of the questionnaire in a concise manner. In the questionnaire (Appendix B), questions one to three were mainly filtering questions. Then onwards, there were six questions which addressed the problems in post-hurricane reconstruction. They answer part two of the research objectives. Each of these six questions has a second part to it, which addresses research objectives three and four. Question ten is directed to answer research objective three. The second part to this question is addressed towards objective four. The next question deals with the first research objective where in we are trying to rank the different problems faced by the contractors. This question incorporates modifications to the problems in reconstruction projects that Atalla and Hegazy (2003) used in their research. The next six questions are addressed towards answering research objective three. Question fourteen is an open-ended venting question, where the responder is asked to add any information, opinion or comment that he thinks is relevant to the study (Rea and Parker 2005).

Table 4. Questionnaire format

Question No.	Total questions	Name	Closed-ended	Open-ended
1,2,3	3	Filtering	1	2
4,5,6,7,8,9	12	Problems	6	6
10	2	Project delivery	1	1
11	1	Ranking of problem	1	0
12	2	Additional problems	1	1
13	2	Clauses	1	1
14	2	Unmentioned	1	1

Research hypotheses

The research focuses on the problems faced in post-hurricane reconstruction projects by various contractors. The Part "a" of Questions numbers 4 to 9 addresses the following hypotheses.

Notations used are H_0 for null hypothesis and H_1 for the alternative hypothesis. Suppose *P* represents the set of six problems- Site logistics, material transportation, labor supply, getting building permits for different construction purposes, political influences in the hurricane affected areas and site location (proximity to highways, wealthy or poor neighborhoods).

For all contractors, problem $p \in P$ and the following hypotheses will be addressed by this thesis:

H_0: All contractors perceive problem p as a major problem in post-hurricane reconstruction.

H_1: Not all contractors perceive problem p as a major problem in post-hurricane reconstruction.

The Part "a" question was asked in the form of attitudes, so the questions were ranged from very low to very high. The Part "b" of each of the question numbers 4 to 9 is open-ended, and was asked to identify different practices involved in solving these problems.

Question number 10 of the questionnaire refers to the importance of the type of project delivery method being used. So, the hypothesis tested here is as follows:

H_0: All contractors perceive the right choice of project delivery system as important in post-hurricane reconstruction projects.

H_1: Not all contractors perceive the right choice of project delivery system as important in post-hurricane reconstruction projects.

Data collection procedure

The questionnaire was sent to the different construction companies by survey software known as "QuestionPro" . This software had a link to the survey webpage, and had the ability to email the survey out to the sample under consideration. Thereafter, the statistics could be monitored periodically. The results were collected and exported to Microsoft Excel software. Since all contractors did not seem to have access to emails and/or to the web; the survey was also carried out via telephone calls. The questionnaire was asked on the phone to contractors, and their answers were obtained. The results were added to the Microsoft Excel software. Refer Appendix C and Appendix D for responses to open and closed-ended questions, respectively.

Pre-test

Before actual dissemination of the questionnaire, a pre-test was conducted among a sample of three commercial contractors from Houston, Texas. Information about those contractors chosen for the pre-test was obtained from The Bluebook, and the websites of the companies showed that they worked in post-hurricane reconstruction projects. First, phone calls were made to identify the project managers who could take the survey. Three of them were emailed the survey.

After they took the survey, they were called up and asked for recommendations and comments. The testing was done to check the ease of answering the survey. It also helped interpret the meanings of the questions in a different perspective (Czaja and Blair 2005). This enabled corrections in the first draft of the questionnaire. It also helped in estimating the time required to fill out the survey. An Institutional Review Board (IRB) approval from Texas A&M University was obtained since there was an involvement of human subjects in the research. The approval announcement is enclosed in Appendix E.

Survey

The survey questionnaire was finalized after the comments made in the pre-testing phase were studied. The survey was then introduced to the sample population in the participating states. Phone calls and emails to the construction companies were made, which led to the understanding that the entire sample was not at ease using emails and the web to answer the survey. As a result, phone calls were made, and the questionnaire was read out to obtain those answers. It was also observed that responses were better, if emails were sent out on Friday evenings. The survey was closed after allowing three weeks for respondents to take it.

DATA ANALYSIS

The data was obtained using Likert scaling procedure because the questionnaire was designed based on the perception of the problems among contractors. According to Champion (1981), researchers reach the ordinal level of measurement when they use Likert scale to derive attitudinal scores. For the analysis of ordinal data, this research has used the Kolmogorov-Smirnov test. The use of this test will be explained later in this section.

Data collection results

The survey was sent to four hundred and fifty contractors, of which fifty one responses were obtained, which makes the response rate to be 11.3%. Of these, 21 responses were obtained through the survey software QuestionPro and the remaining was obtained through telephone calls. Table 5 below explains the distribution of responses among contractors based on three categories.

Table 5. Distribution of responses among different type of contractors

Category	Type	Number of Responses	Percentage
Small	Projects less than $10 million	14	33.3
Medium	Projects between $10 million to $50 million	20	39.2
Large	Projects more than $50 million	17	27.5
Total		51	100

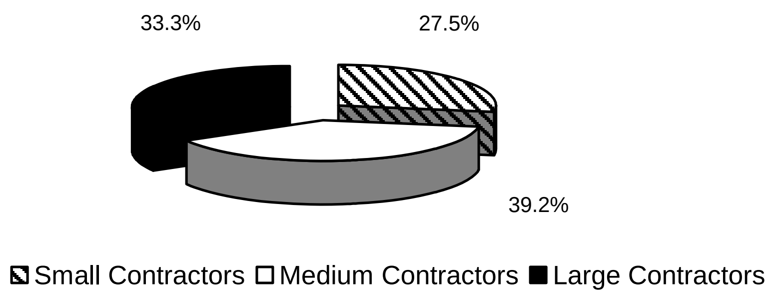


Figure 3. Piechart showing distribution of responses (survey question 3)

The different categories of contractors who answered the questions are shown in the Figure 3.

There were twelve open-ended questions. The answers to these questions were coded into categories. The results obtained would be explained using descriptive statistics.

Descriptive statistics

The survey was taken by vice presidents, chief executive officers (CEOs), project engineers (PE), project managers (PM), sales personnel and other people involved in some stage of the construction process. They were categorized into the following four categories.

1. Administrative personnel (vice-presidents, CEOs, presidents)
2. Executive personnel (project managers, project executives)
3. Others (human resource specialists, sales director, estimators)

The distribution of responses in the survey expressed as a percentage is shown in Figure 4 below.

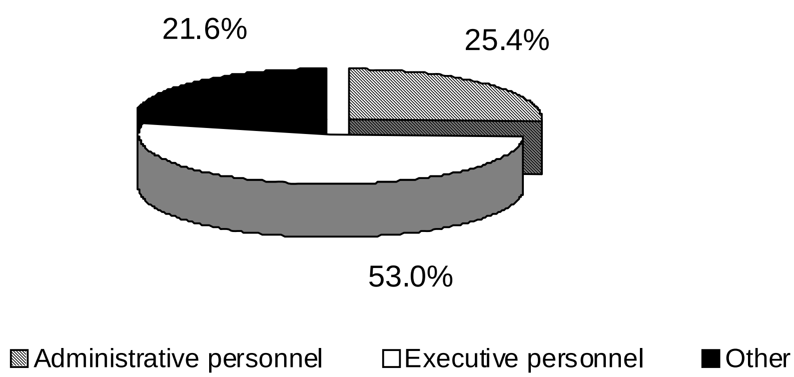


Figure 4. Distribution of responses based on title of participants as a percentage

Question number 13a dealt with the effect of contracts and clauses on post-hurricane reconstruction projects and if contractors feel that changes in those can change the outlook towards reconstruction projects. The options to answer this question was “Yes”, “No” and “Maybe”. Figure 5 reveals that a high percentage of contractors do not feel that changes in clauses of contracts or government policies can help change the outlook towards reconstruction processes. Contractors who answered “Yes” to this question were asked to mention those clauses or policies that could make a difference in future projects. Only one response was obtained for this question. However, it was not possible to conclude anything from this response.

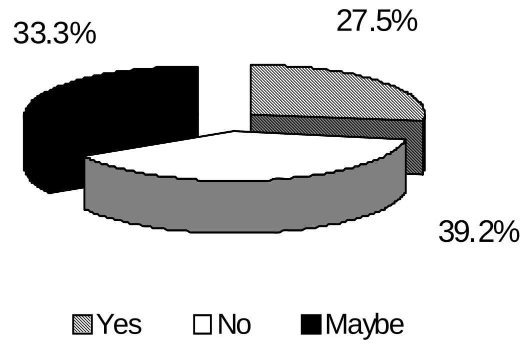


Figure 5. Percentage believing that clauses in contracts or government policies can help change the outlook towards reconstruction projects

Question number 14a was asked to find if there was anything that the contractor believes was important in post-hurricane reconstruction which was not mentioned in the survey. Figure 6 shows the distribution of the answers to this question, from which we can learn that the majority of respondents (71%) said that they did not believe that something was missed out from the survey which is relevant to the topic.

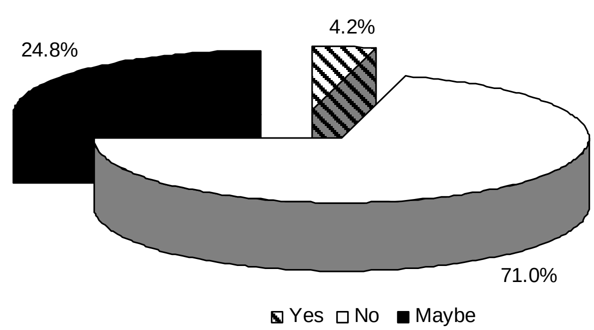


Figure 6. Distribution of responses to question 14a

Histograms are graphs that show diagrammatically the frequency of occurrence in a distribution of scores. Since the data was ordinal in nature, i.e. it was ranked in a scale ranging from 1 to 7, frequency polygons were used to represent the distribution of responses.

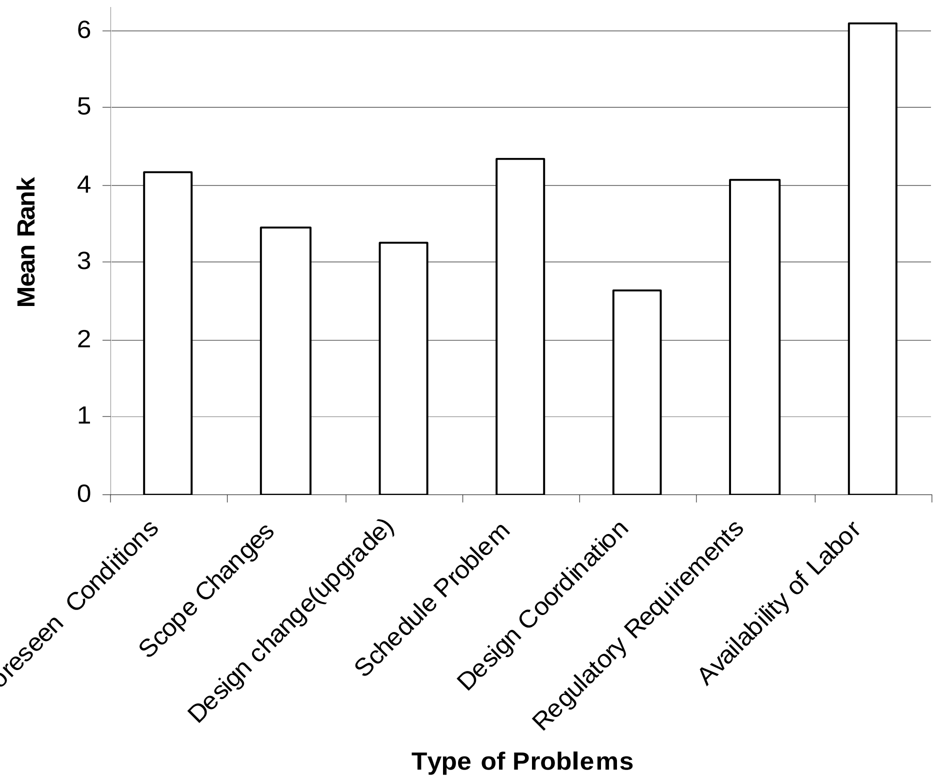


Figure 7. Ranking of problems

Question number 11 is used to find the ranking of the problems among the contractors in post-hurricane reconstruction projects. From the histogram of the mean rankings (Figure 7) based on responses from 51 contractors, we see the order in which they were ranked from availability of labor ranking the highest to design coordination being the least problematic.

The following boxplot (Figure 8) is used to explain the ranking of problems faced in post-hurricane reconstruction. The horizontal line in each of the boxplot represents the median (most number of responses for a particular rank) for each of the seven problems in the question.

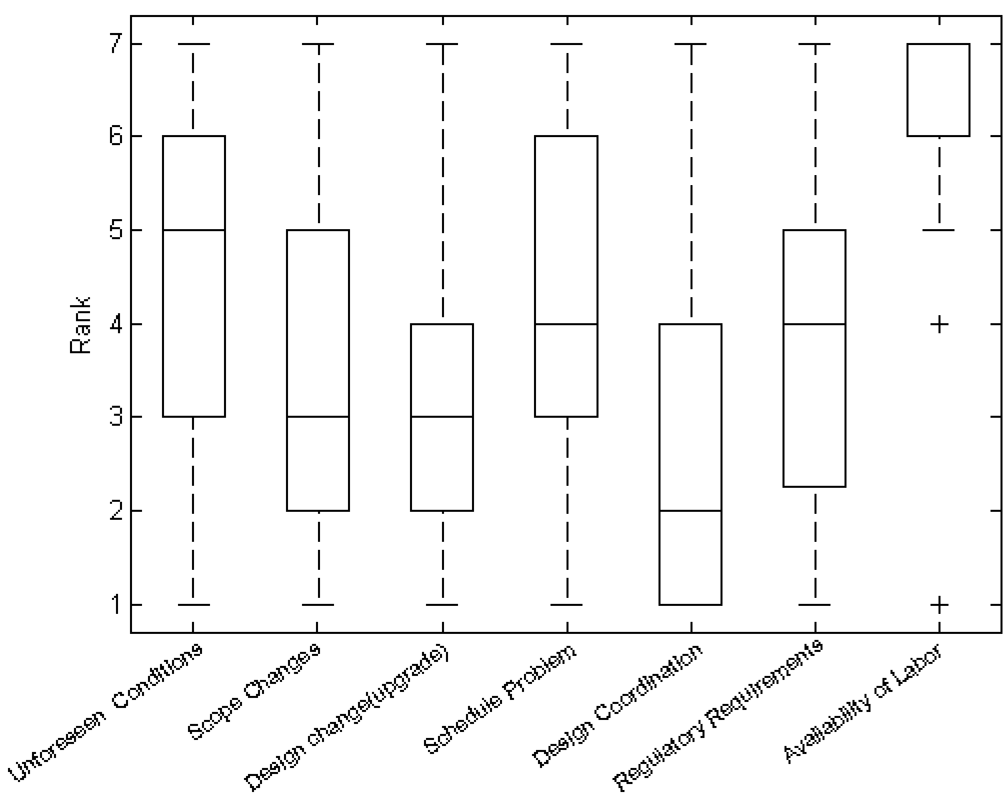


Figure 8: Boxplot explaining trend of problems

The boxplot (Ott and Longnecker 2001) shows the symmetry of the distribution and also incorporates measure of central tendency and location to help study the variability of the scores and the concentration of scores in the tails of the distribution. In boxplots, if the median line is closer to the lower quartile than to the upper, there is a greater concentration of scores on the lower side of the median within the box than on the upper side. From the above boxplot, we see the following:

- The answers range from rank 1 to 7 for all problems except that of availability of labor. None of the distribution of scores is symmetric for any of the problems, since the median does not lie at the center of any of those distributions.
- Availability of labor seems the most highly ranked problem, with majority of responses (median) being 7. From the Figure 7, we can also see that its above 6. From calculated values, it is 6.07.
- Schedule problem (median 4) and unforeseen existing conditions (median 5) are ranked high.
- Regulatory requirements (median 4) and scope changes (median 3) are the ones that are next highest.
- Design changes (upgrade) (median 3) and design coordination (median 2) are the ones that contractors do not really face much problem in post-hurricane reconstruction.

Labor seems to be one of the most problematic factors in post-hurricane reconstruction projects, and some of the open-ended questions bear testimony to this fact. Provision of temporary housing, power and water to labor is a difficult task in post-hurricane situations. So, they have been ranked the highest by majority of contractors. This will be better explained by the significance tests performed on the data obtained to the question of hiring of labor problem. The next problems with high ranks are unforeseen site and schedule problem conditions. In post-hurricane reconstruction projects, unforeseen problems arise mainly because of the preceding hurricane damage caused. So, chances of deviations in predictions of the earth conditions and water tables are prevalent. Therefore, uncertainties increase in such situations. Schedule problem is a part of site logistics. There is another question about the problem of site logistics, which will discuss this problem in more detail. A feature specific to reconstruction projects is the scope changes introduced at different stages of the project, which cause a lot of inconvenience to the contractors. Scope changes however are governed by clauses in the contract which help the contractor to get adequately compensated for such cases. Design changes and regulatory requirements are not so much a problem for contractors, mainly because it is not under their control as they are factors external to the construction process. On a comparative scale, design changes are not much of a problem for the contractor, but for the architects and the regulatory requirements are under the government. So, contractors are not able to do much to tackle problems related to these factors. Design coordination was ranked the least. The reasons behind this are mainly that this too involves more of an architect involvement than that of contractors.

The hierarchy of the problems from most problematic to least problematic obtained from the responses is the order in which the histograms below have been arranged. Also, individual histograms for each of the problems distributed among small, medium and large contractors have been included below. A problem is considered as a major problem if it is ranked at six or above. If it is ranked below three, then the problem is considered as minor.

This will explain how the trends in the responses from small, medium and large contractors involved in the survey.

Availability of labor and ease of hiring

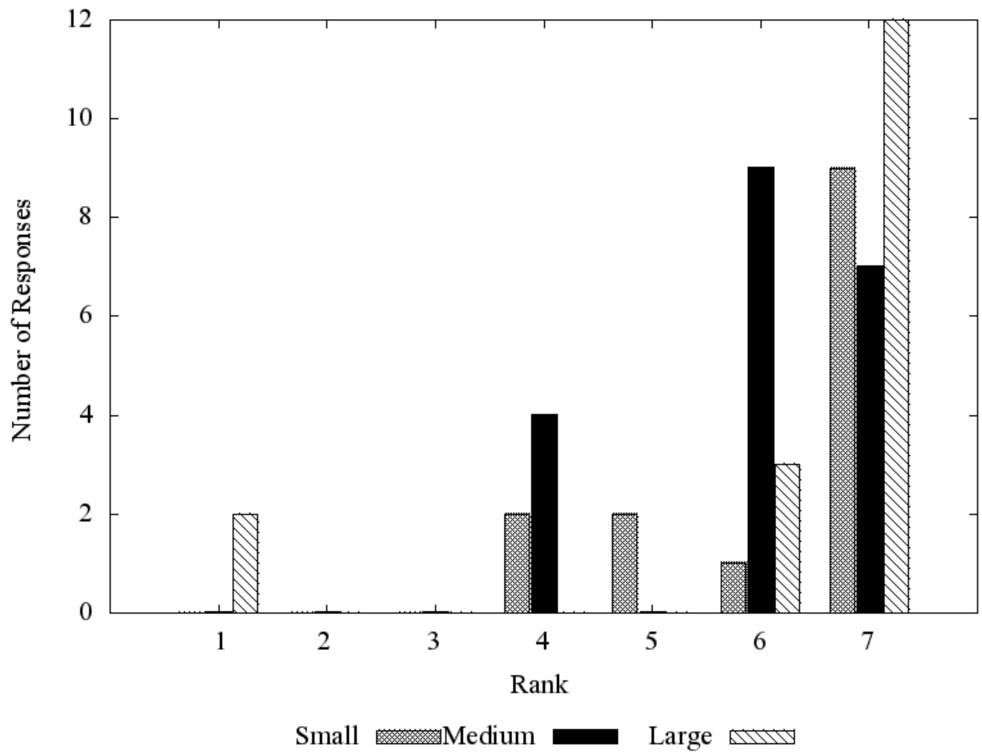


Figure 9. Histogram of responses among small, medium and large contractors concerning labor

From Figure 9, we see that majority of large, medium and small contractors feel that labor supply is a major problem (ranked six or above). The percentages of small, medium and large contractors considering the availability of labor and ease of hiring them as a major problem are 71%, 80% and 88% respectively. This percentage seems to increase with the increase in the size of the contractors. The reason is that small contractors require a comparatively smaller number of laborers, which can be hired from the local communities; whereas, for medium and large contractors, it is difficult to mobilize a large number of skilled employees after a hurricane.

<u>Schedule problem</u>

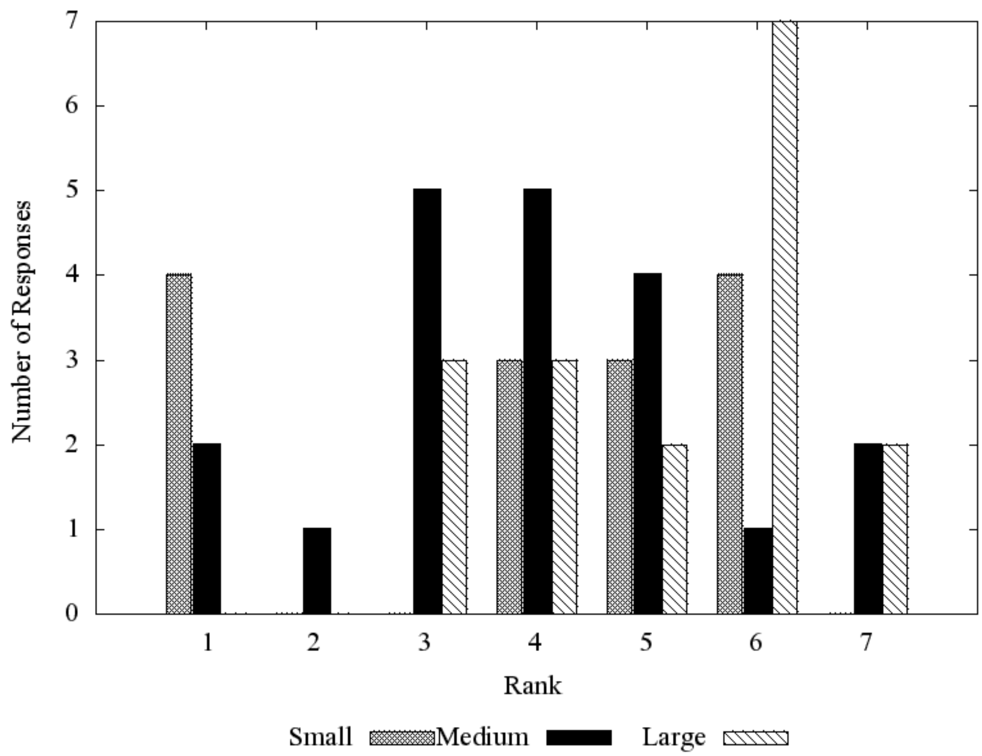


Figure 10. Histogram of responses among small, medium and large contractors concerning the schedule problem

From Figure 10, it can be concluded that majority of the responses tend towards the middle of the scale. However, no particular trend is clearly visible.

Unforeseen site conditions

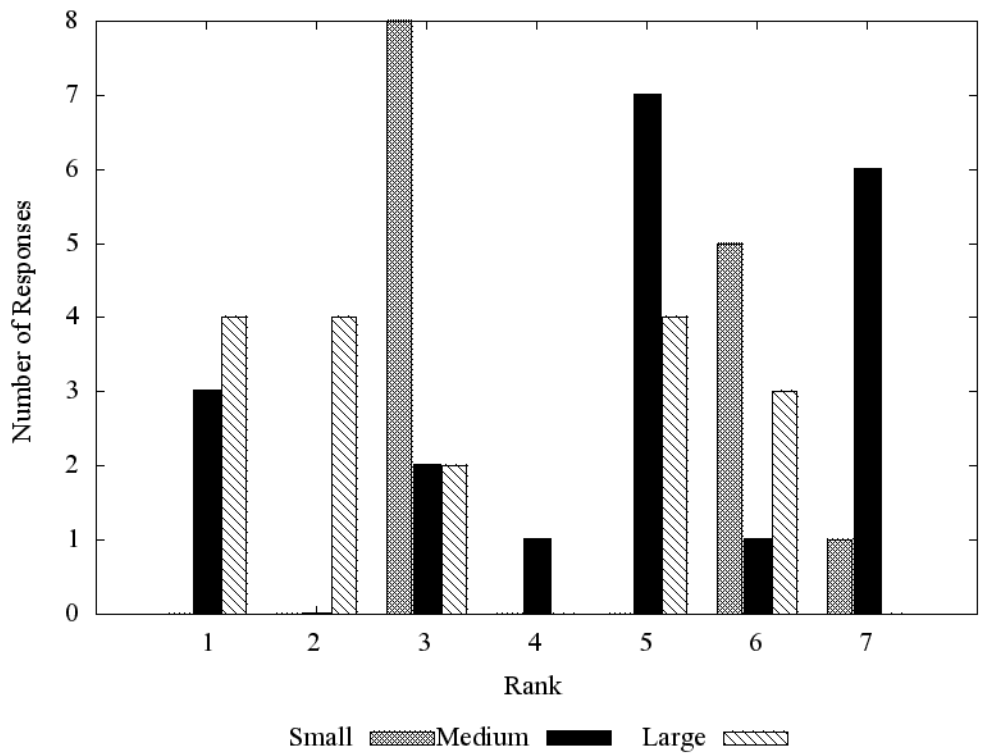


Figure 11. Distribution of responses among small, medium and large contractors concerning unforeseen site conditions

Forty three percent of small contractors feel that unforeseen site conditions are a major problem compared to 35% among medium contractors and 18% among large contractors. The general trend observed in Figure 11 is that this percentage decreases with the increase in size of the contractor. This is because larger contractors invest available resources on preconstruction surveys in the initial phases of the project. Large contractors tend to realize that unforeseen site conditions could lead to repeating work, which is very harmful to the project, and so as a precaution, adequate measures are taken to avoid such a scenario. Also, larger contractors normally have the ability and expertise to cope with most of the unforeseen site conditions. This could be due to experience and extensive resources availability in comparison to the smaller contractors.

<u>Regulatory requirements</u>

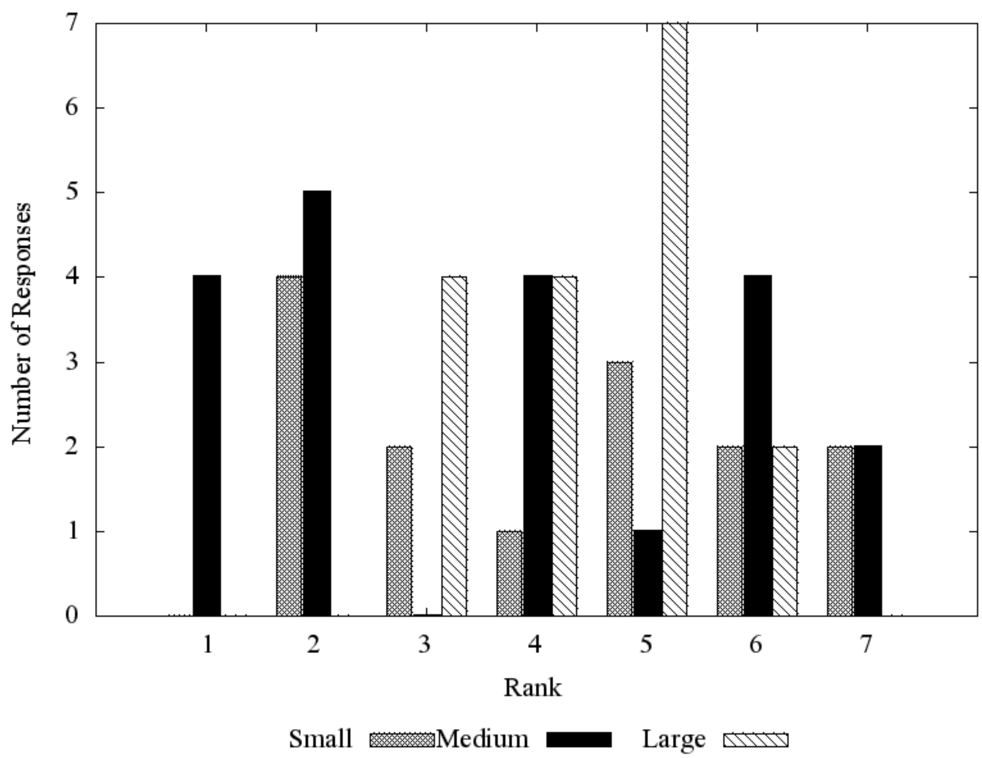


Figure 12. Distribution of responses among small, medium and large contractors concerning regulatory requirements

The distribution of responses is given in Figure 12, at which no clear trend is visible with regards to the problem of regulatory requirements.

Scope changes by owner

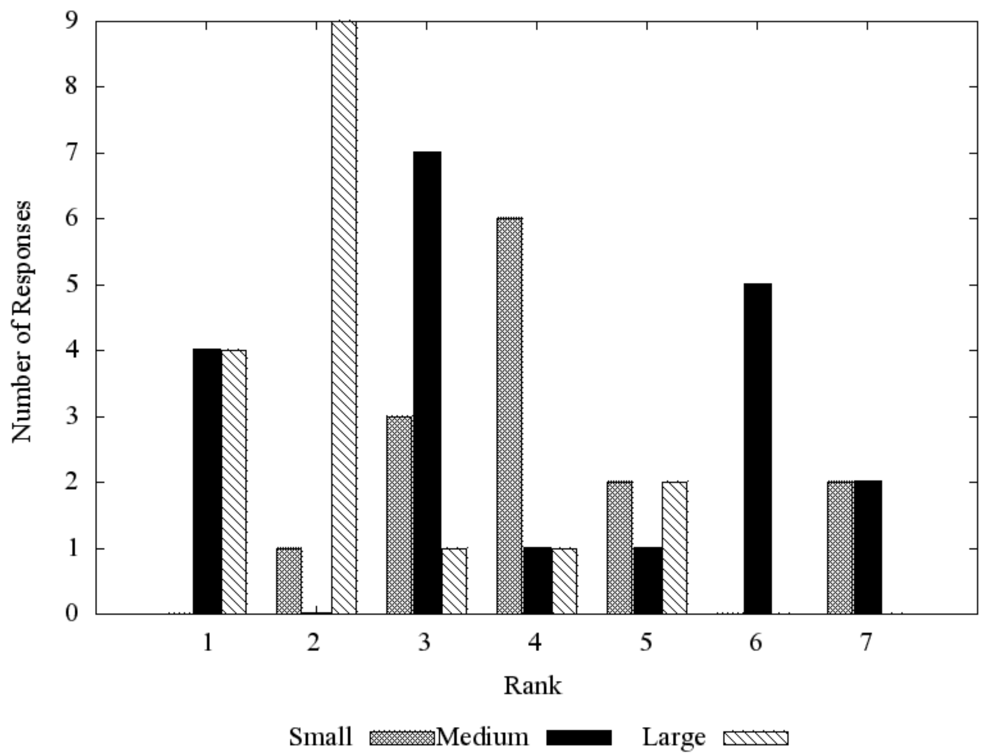


Figure 13. Distribution of responses among small, medium and large contractors concerning scope changes by the owner

Seventy six percent of the large contractors do feel that scope changes are a minor problem, whereas twenty percent of the medium contractors and seven percent of the small contractors consider this to be a minor problem. This problem deals with scope changes by owner as shown in Figure 13. So, when owners make certain demands in the middle of the project, the contractor tries to incorporate those in order to have repeat clients. Including such scope changes in the middle of the projects is not easy, and so small contractors feel that it more of a problem relative to medium and large contractors. Large contractors may have higher ability to cope with scope changes, and that could be one of the reasons for them to not feel that it is a major problem.

Design change (upgrade)

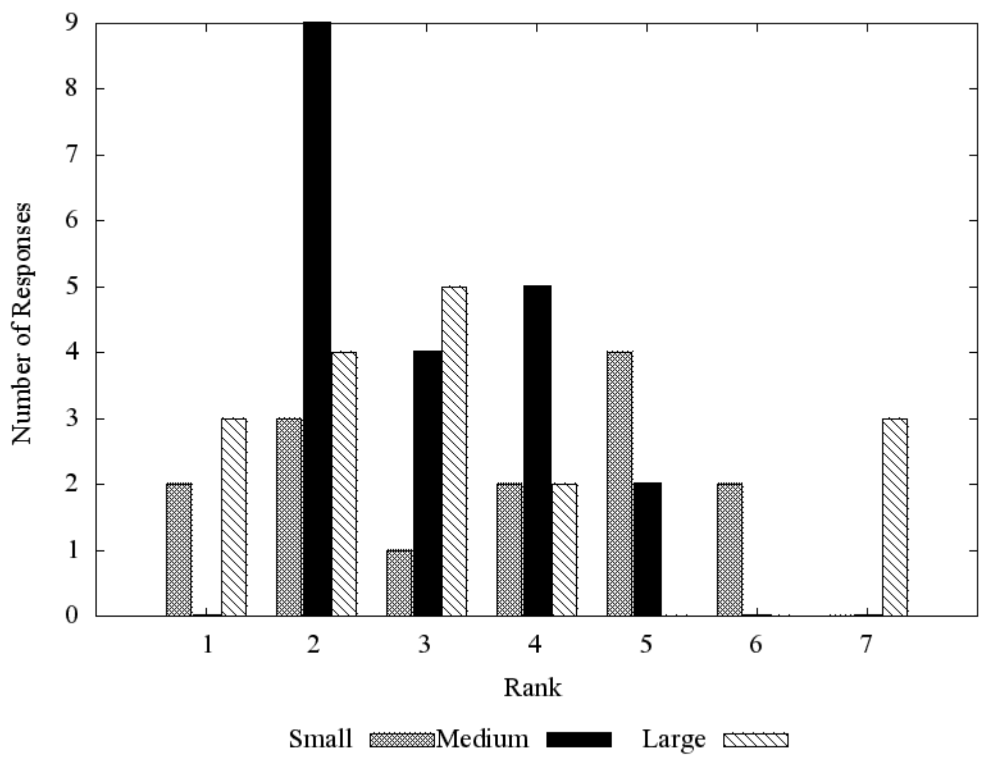


Figure 14. Distribution of responses among small, medium and large contractors concerning design change (upgrade)

From Figure 14, it can be concluded that majority of the responses tend towards the lower end of the scale. However, no particular trend is clearly visible.

<u>Design coordination</u>

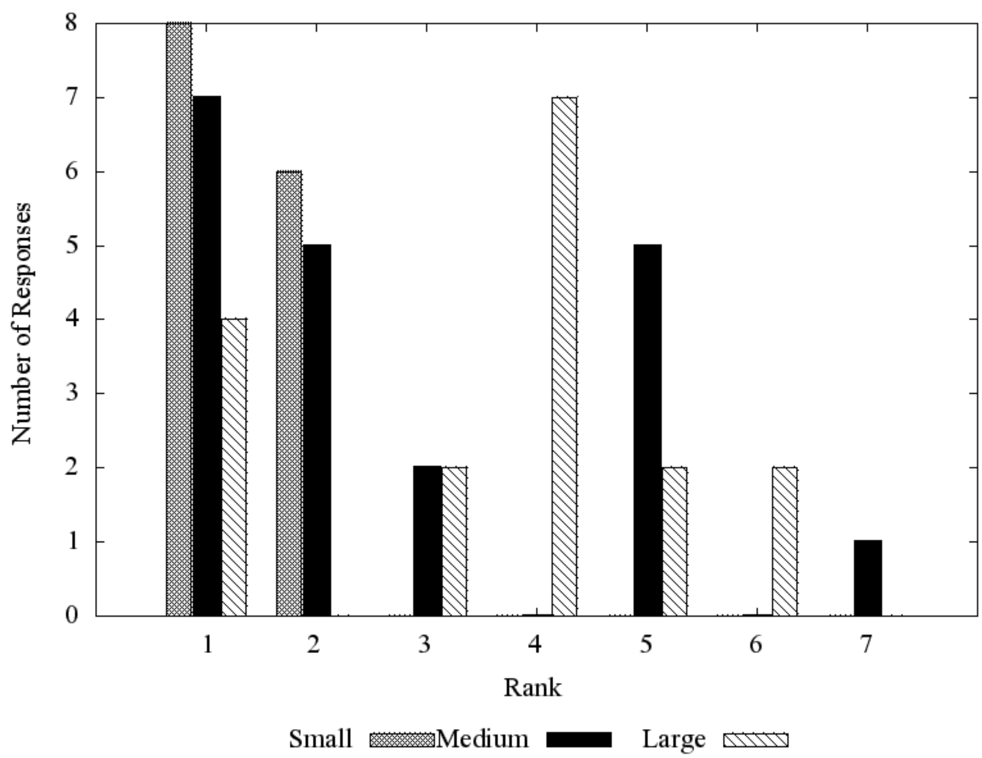


Figure 15. Distribution of responses among small, medium and large contractors concerning design coordination

From Figure 15, it can be seen that most of the contractors think that design coordination is a minor problem. All small contractors that have been surveyed feel the same. Comparatively, 60% of the medium contractors and 24% of the large contractors feel that way. This is probably due to the nature of reconstruction projects, where in post-hurricane situations design coordination seems simpler because all architects, designers are working in tandem to complete the projects as fast as possible and to get the project completed as soon as possible.

Hypotheses testing

Kolmogorov-Smirnov tests were performed to test significance of difference for data measured as per an ordinal scale. This test is a goodness-of-fit procedure. Goodness-of-fit implies a "fit" between an observed set of frequencies and an expected set of frequencies. It mainly measures how well, one fits the other, hence the name.

Here, a distribution of frequencies is arranged through 5 ranked categories (Champion 1981). This is the observed distribution which is compared with the null hypothesis distribution.

Assumptions in this test are as follows:

1. Randomness of responses
2. Ordinal level of measurement underlying the variable studied

This one-sample test can be applied to samples divided into any number of graded categories. If on the basis of collected data, it is decided that the null hypothesis being tested is rejected, there is always some likelihood that the decision being taken is wrong. This error is known as type I (alpha α) error. Whenever it is decided to fail to reject the null hypothesis, and there is some likelihood that it is false and it should be rejected, type II (beta β) error occurs. In this case, the Kolmogorov-Smirnov test has a power of 85-90% in relation to rejecting false hypotheses; i.e. there is a 10-15% chance that the researcher could be wrong in making a decision to reject the null hypothesis. Also, there are no sample size restrictions.

According to the Kolmogorov-Smirnov test (Marques deSá 2003), the null hypothesis is written as:

H_0: Data variable χ has a cumulative probability distribution F $\chi(x) \equiv F(x)$

$S_n(x)$ is the observed cumulative distribution of the random sample, $x_1, x2_{...}x_n$, also called empirical distribution. Assuming the sample data is sorted in increasing order, the values of $S_n(x)$ are obtained by adding the successive frequencies of occurrence, k_i/n, for each distinct x_i.

Under the null hypothesis, small deviations of $S_n(x)$ from $F(x)$ are expected. The Kolmogorov-Smirnov test uses the largest of such deviations as a goodness-of-fit measure:

D_n=max $|F(x)-S_n(x)|$, for every distinct xi.

The Kolmogorov-Smirnov test rejects the null hypothesis at level α if $D_n > d_{n,\alpha}$ is such that:

$P_{Ho} (D_n > d_{n,\alpha}) = \alpha$

MATLAB (Matrix Laboratory) software was used to perform the tests of significance by using the Kolmogorov-Smirnov test.

Using MATLAB command *kstest*, the meaning of the parameters and return values when testing the data sample x, at level alpha, is as follows:

p: Observed significance

h: Test result, equal to 1 if H_0 can be rejected, 0 otherwise.

kstat: Value of Kolmogorov-Smirnov statistics

<u>Application of Kolmogorov-Smirnov test</u>

The data collected was on a rating scale of 1 to 5. Due to responses like zero in few cells, the cells were merged into three categories of low, medium and high; where responses below “3” were classified as low, while those above “3” were classified as high, and those at “3” were classified as medium.

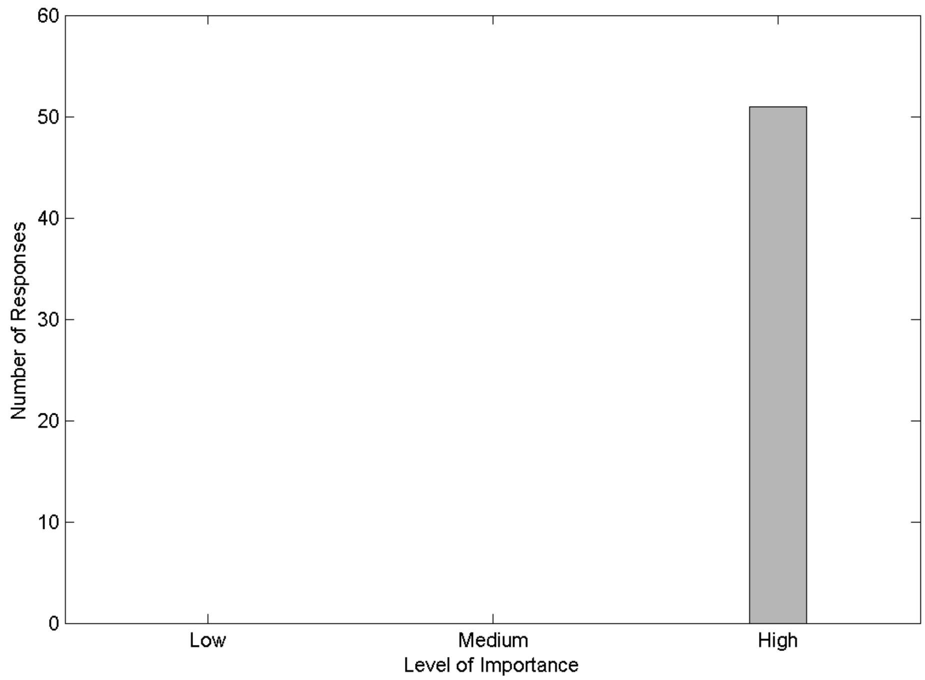


Figure 16. Null hypothesis for each problem considered

For all contractors, the null hypothesis that was considered was that all responses fell in the category “4” or “5”, as shown in Figure 16. The observed distribution was compared to the null hypothesis.

1. H_0: All contractors perceive site logistics as a major problem in post-hurricane reconstruction.

H$_1$: Not all contractors perceive site logistics as a major problem in post-hurricane reconstruction.

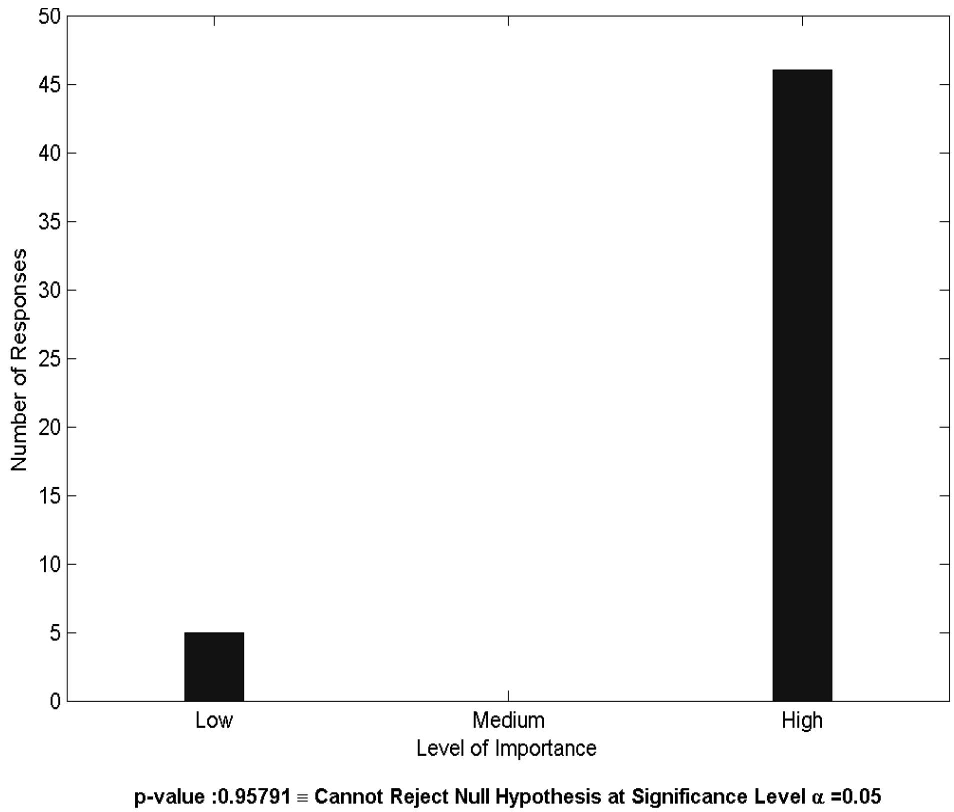


Figure 17. Site logistics (actual distribution)

From Figure 17, it is seen that the p-value obtained from the Kolmogorov-Smirnov test is 0.95791, implying that the null hypothesis cannot be rejected at a significance level of 0.05. There is not enough evidence to reject the hypothesis that all contractors perceive site logistics as a major problem.

2. H_0: All contractors perceive material transportation as a major problem in post-hurricane reconstruction.

   H_1: Not all contractors perceive material transportation as a major problem in post-hurricane reconstruction.

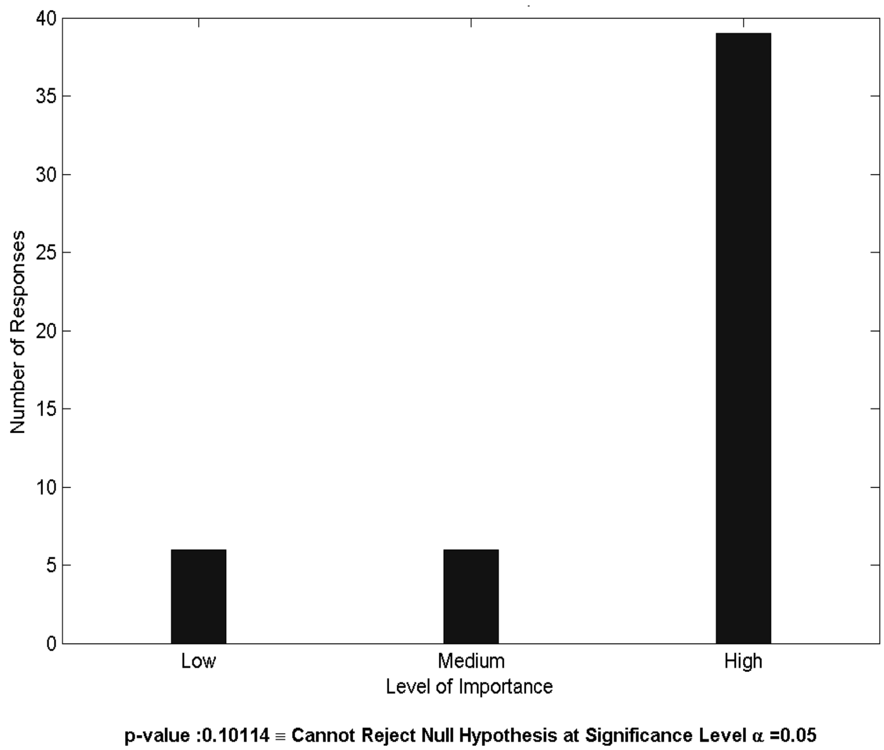
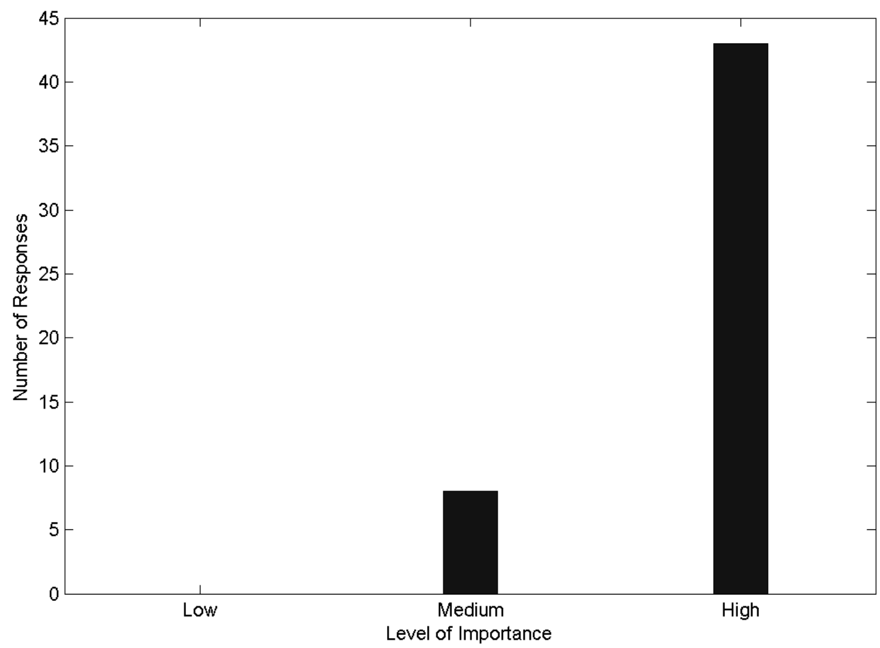


Figure 18. Material transportation (actual distribution)

From Figure 18, it is seen that the p-value obtained from the Kolmogorov-Smirnov test is 0.10114, implying that the null hypothesis cannot be rejected at a significance level of 0.05. There is not enough evidence to reject the hypothesis that all contractors perceive material transportation as a major problem.

3. H_0: All contractors perceive labor supply as a major problem in post-hurricane reconstruction.

   H_1: Not all contractors perceive labor supply as a major problem in post-hurricane reconstruction.



p-value :0.52097 ≡ Cannot Reject Null Hypothesis at Significance Level α =0.05

Figure 19. Labor supply (actual distribution)

From Figure 19, it is seen that the p-value obtained from the Kolmogorov-Smirnov test is 0.52097, implying that the null hypothesis cannot be rejected at a significance level of 0.05. There is not enough evidence to reject the hypothesis that all contractors perceive labor supply as a major problem.

4. H_0: All contractors perceive getting building permits for different construction purposes as a major problem in post-hurricane reconstruction.

   H_1: Not all contractors perceive getting building permits for different construction purposes as a major problem in post-hurricane reconstruction.

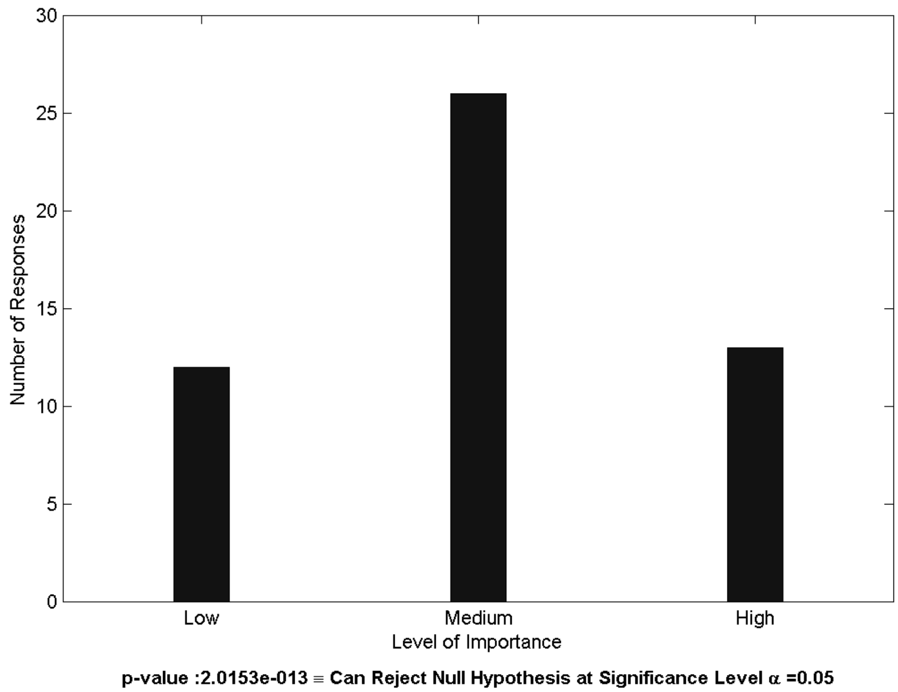


Figure 20. Building permits (actual distribution)

From Figure 20, it is seen that the p-value obtained from the Kolmogorov-Smirnov test is 2.01e-013, implying that the null hypothesis can be rejected at a significance level of 0.05. There is enough evidence to reject the hypothesis that all contractors perceive getting building permits for different construction purposes as a major problem.

5. H_0: All contractors perceive political influences in the hurricane affected areas as a major problem in post-hurricane reconstruction.

   H_1: Not all contractors perceive political influences in the hurricane affected areas as a major problem in post-hurricane reconstruction.

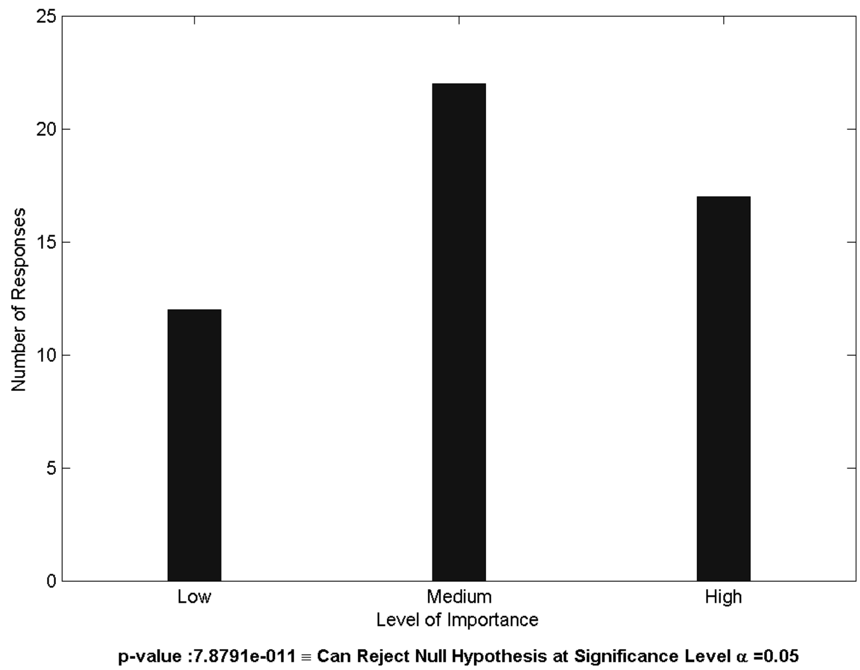


Figure 21. Political influence (actual distribution)

From Figure 21, it is seen that the p-value obtained from the Kolmogorov-Smirnov test is 7.88e-011, implying that the null hypothesis can be rejected at a significance level of 0.05. There is enough evidence to reject the hypothesis that all contractors perceive political influences in the hurricane affected areas as a major problem.

6. H_0: All contractors perceive site location (proximity to highways, low-income groups or high-income groups) as a major problem in post-hurricane reconstruction.

   H_1: Not all contractors perceive site location (proximity to highways, wealthy or poor neighborhoods) as a major problem in post-hurricane reconstruction.

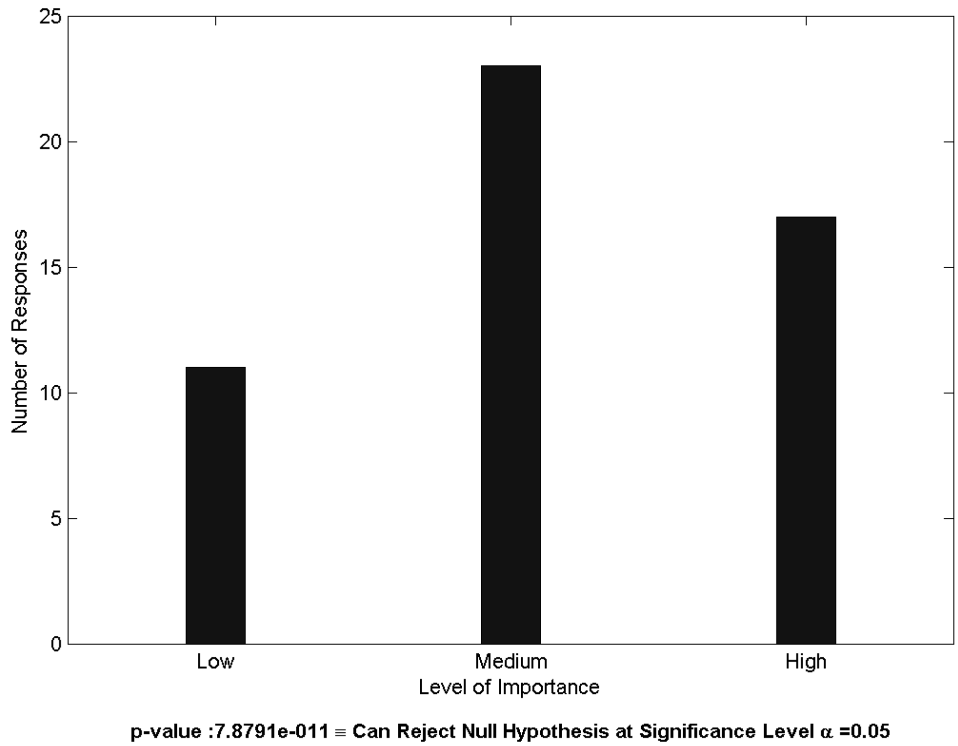


Figure 22. Site location (actual distribution)

From Figure 22, it is seen that the p-value obtained from the Kolmogorov-Smirnov test is 7.88e-011, implying that the null hypothesis can be rejected at a significance level of 0.05. There is enough evidence to reject the hypothesis that all contractors perceive site location as a major problem.

For project delivery systems, the hypothesis was tested as follows.

H_0: All contractors perceive the right choice of project delivery system as important in post-hurricane reconstruction projects.

H_1: Not all contractors perceive the right choice of project delivery system as important in post-hurricane reconstruction projects.

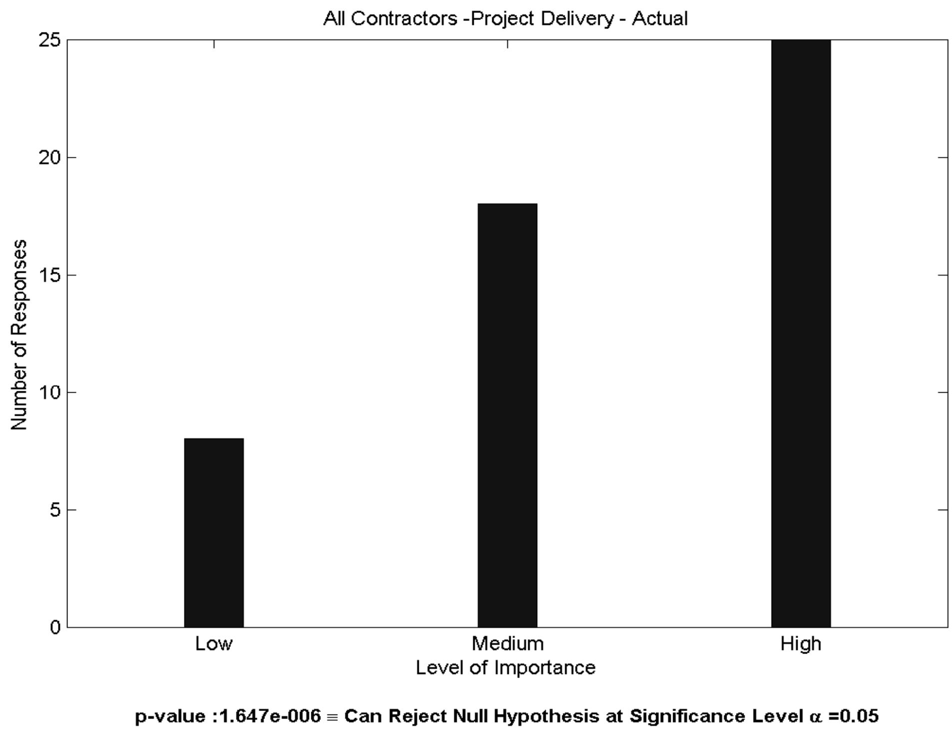


Figure 23. Project delivery system (actual distribution)

From Figure 23, it is seen that the p-value obtained from the Kolmogorov-Smirnov test is 1.6470e-006, implying that the null hypothesis can be rejected at a significance level of 0.05. There is enough evidence to reject the hypothesis that all contractors perceive project delivery system as an important factor in post-hurricane reconstruction.

From the above analysis, it can be observed that site logistics, material transportation and labor are perceived as a major problem; whereas getting building permits, political influences and site location are not perceived as a major problem by all contractors. Further study reveals that building permits, political influences and site location are external factors over which a contractor does not necessarily have control. On the other hand, site logistics, material transportation and labor are more flexible for a contractor to control.

The survey was structured in such a way that if a contractor answered “high” or “very high” for a particular problem, he would have to answer the question about the practices he follows in order to deal with that problem. These open-ended questions have been analyzed as follows.

Findings from respondents’ comments

A number of responses were obtained in the open-ended questions. These were meant to find out the practices used to solve the different problems in post-hurricane reconstruction. Open-ended questions are advantageous as they help respondents to voice their thoughts and feelings in their own words (Weisberg et al. 1996). For analyzing these questions, the respondent’s answers have been coded into categories as presented below. All the findings from the open-ended questions have been summarized in Appendix C.

Considering each of the six problems, the practices can be categorized and explained as follows.

Site logistics

In the site logistics plan, the construction sequence of the project is related to the site safety, security and movement of labor and materials. The problems after a hurricane are acute and the safety and security become a very important issue in contrast to a new construction project.

The site logistics plan consists of the following:

a. Protection of adjacent property, roads and utilities
b. Location of construction fences and gates
c. Temporary storage of materials and equipments
d. Location of hoists and lifts
e. Temporary roads, staging areas, parking, temporary offices and storage trailers.

Site constraints that may affect the site logistics plan are hazardous materials or contaminated soil located on site, noise restrictions, dust protection, storm water run-off, restrictions on delivery or movement of materials and debris from the site and potential neighborhood opposition and complaints (Hess et al. 2007). These can prove a major issue in post-hurricane reconstruction projects because there could be changes that the topography might have undergone because of collapsing of structures and geophysical changes caused by the hurricane. After a hurricane, availability of resources is an issue and so, a well-developed site logistics plan helps to maintain the efficiency of the reconstruction process.

The practices that have been suggested by most of the contractors fell into the following categories.

Planning

In post-hurricane reconstruction projects, planning must be more aggressive than in normal scenarios since the supply of major items gets uncertain. To tackle these problems, preemptive action must be taken, for example pre-hurricane planning, planning with subcontractors through meetings before the start of the project, and strategic planning of projects. This also includes pre-disaster analytics to prepare the staging of materials, resources and communications.

Scheduling

Optimum resource allocation, space scheduling, and use of building information modeling (BIM) were some of the suggestions made by the contractors. Just-in-time (JIT) concepts were also suggested for improved site logistics. Though these practices are used in new construction projects, the awareness among a contractor pursuing post-hurricane reconstruction projects about these is very less. Use of these techniques, knowing that there could be material shortage and uncertainty of supplies at any given point of time, is found to be important for scheduling post-hurricane reconstruction projects. The amount of rigor and aggressiveness with which they should be applied in post-hurricane reconstruction projects is high because these projects are a part of the recovery process so as to mobilize the stagnant economy in the aftermath of a hurricane.

Coordination

This involves mainly on-site labor management, language training of workers and personnel. One of the suggestions was that the lead members of the reconstruction team must coordinate to the greatest extent possible with the owner of the property depending on the location of the damage. English as Second Language (ESL) classes to workers sponsored by companies can help coordination through better communication. During a reconstruction project, contractors mainly focus on completing the work as soon as possible, and do not pay attention to such matters. In a post-hurricane project, if labor is outsourced from other areas, it becomes necessary for the contractors to teach them English so that coordinating them is not a problem. In contrast to this, under normal circumstances, outsourcing might not be needed, and local labor can be used to complete the project.

Supply Chain Management (SCM)

Supply Chain Management in the field of construction was mentioned as one of the innovative ideas given by the contractors. They also felt that adopting this method to this industry would be beneficial because each person in the chain would be responsible for their role and decision-making would not be a chaotic process. SCM is a concept originally taken from manufacturing industry which uses JIT production and logistics. In SCM, multiple stages of the supply chain are covered, including the actors involved. In the construction industry, the actors are contractors, sub-contractors and suppliers, when we mainly deal with site logistics. Their interactions need to be carefully studied and the SCM methodology suggests redesign, control and continuous improvement. For example, suppliers would have to reengineer the procurement process, install joint coordination of logistics and recurring product development programs. Also, SCM helps trace the stage at which problems occur, and so improvements on those can help correct the problems. In post-hurricane project scenarios, suppliers would be aware of the demand for certain materials just after the hurricane, and so they can have their procurement system ready to deliver on demand, and thus hasten the process. The contractors are an important part of the supply chain, so they can preorder items after a hurricane to counter the hike in demand. Thus, supply chain management can be made effective in post-hurricane reconstruction projects.

Experienced site personnel

Use of experienced site personnel, project managers and superintendents for better problem solving has been suggested by few contractors. In post-hurricane reconstruction projects, there are chances of encountering problems that can be best handled by project managers and superintendents, who have worked in this sector before. The aspect of high uncertainty regarding the neighboring community and people is a key item in such projects. They need employees with the experience to understand the attitudes of people around the project. After a hurricane, recovery is the first priority of the community. Though part of the community will staunchly support such reconstruction projects, there will be a portion of the population that keeps being perennially suspicious about the sentiments of the project. Thus, site personnel can help to calm the averse behavior of communities because of previous experience and intelligent decision-making.

<u>Material transportation</u>

Strategic planning

Majority of the responses were related to planning and how good planning can help to overcome the problems generally faced with material transportation. One of the companies said that in order to prepare for hurricanes on the Gulf coast, they had stocked pre-cut plywood near some identified high risk locations which would be installed once the likelihood of a hurricane has been established as high. Also, locating generators at strategic points can help companies with multiple branches to work from the local points to improve the speed of the recovery process. Stocking seemed to be one of the options recommended by many contractors in the event of a hurricane, especially items that are often used for many of these projects like plywood and drywall materials. Temporary chillers and high capacity water pumps were some suggestions.

Supply Chain Management (SCM)

Material transportation problems could be resolved by applying supply chain management in construction. This would alleviate those problems to a certain extent.

Interrelated to site logistics

Material transportation is a part of site logistics. So, practices found to resolve site logistic issues can be used to improve material transportation.

<u>Labor supply</u>

Outsourcing

Many of the contractors opined that outsourcing of labor was needed in hurricane affected localities because majority of the hurricane affected people would have lost their homes and belongings. However, to keep the process ongoing, these outsourced people should be skilled labor who would have sufficient experience in completing the jobs.

Hiring local employees

Some of the contractors felt that labor could be hired from the hurricane affected localities at a relatively low cost, and that would indirectly; give them a means to survive since they could start earning. In New Orleans, Spanish workers had started coming into the areas dominated by Afro-American population, so there was a general unhappiness among the dominant communities. Thus, contractors should prefer hiring skilled labor, irrespective of their community.

Preferred providers

Use of preferred vendors and pre-hurricane relationships was popular because some contractors used labor suppliers that they had used previously. Also, when some companies who are regularly involved in post-hurricane reconstruction type of projects come across such projects, they are used to hiring employees from certain agencies. That way, they follow a certain set pattern after a hurricane strikes a particular region. This is very common in Florida, since due to regular hurricanes, contractors have regional suppliers who can be used at such times. These practices help to improve the speed of recovery and rebuilding process.

Getting building permits for different construction purposes

Since this category was not marked as a major problem by majority of contractors, there were very few answers to this open-ended question.

Also, the main viewpoint that was expressed here was that since recovery and rebuilding is a priority for the local government, building permits are normally issued fast. This was done until enough reconstruction projects were completed, and the hurricane affected regions went back to normalcy. Use of photographic records is one of the methods for helping the inspection process to proceed faster.

Political influences in the hurricane affected areas

Some contractors were of the opinion that political influences help in getting building permits faster. At the same time, there was an opinion that if the hurricane occurs in an area where a congressman or mayor hails from, the reconstruction process gets faster because of the slightly relaxed regulations for building permits. Also, if there is representation of contractors at a local level, it could help in legislative decisions to some extent.

Sometimes, political influence of contractors help them to control other factors in a post-hurricane scenario in a location where the contractor does major amount of works, and has several projects simultaneously running. Such contractors may gain significant benefit since they are already familiar with the local clauses and policies.

Site location (proximity to highways, neighborhoods of low-income groups and high-income groups)

The problems faced due to a site location situated away from highway or in a neighborhood with low-income group is multiple. The main issues that crop up are security concerns and difficulty in bringing materials and labor to the job-site directly without much use of public transport. However, the responses obtained are categorized as follows.

Preconstruction surveys

Many contractors opined that site location was not a major problem; however a few said preconstruction surveys seemed to help analyze the neighborhood and decide on the projects' safety. Preconstruction surveys help to find out where the workers could be given temporary housing and shelter. If the project team is coming from outside the hurricane affected region, then the survey of schools and housing in the locality becomes pertinent.

Site layout plan

A good site layout plan helps to tackle the traffic problems in and around the site. It is necessary to plan in advance for such projects adequately because the uncertainty aspect is higher there. Understanding the post-hurricane situation and locating the site-office strategically with necessary security is important. In a post-hurricane project scenario, different communities are affected. This causes some of the people to resort to dishonest means like stealing or rampaging property in search of a livelihood, to recover from the destructions caused by the hurricane. In a hurricane-affected community, the likelihood of such attacks is increased and so, security is a key-item. Security of employees, materials and property should be taken care of by employing extra security personnel, if need be.

<u>Project delivery system</u>

Many responses obtained regarding the type of project delivery system preferred were the IDIQ (Indefinite Delivery Indefinite Quantity) and the negotiated system of contracting, as the responses suggested. Job order contracting (JOC) system is an IDIQ contract between the owner of a facility and a general contractor. It is a competitively bid contract. In a unit price book (PUB), basic construction units of work are defined and the unit prices to be paid for each of the construction line items are specified in it. This is a high performance delivery system for facility renovations and minor construction. In most post-hurricane reconstruction projects, the JOC process is recommended for customer satisfaction, quality construction, and timely delivery (Kashiwagi and Sharmani, 1999).

CONCLUSIONS

Conclusions and recommendations

From the study, it can be concluded that site logistics, material transportation and labor supply are considered to be major problems in post-hurricane reconstruction by most contractors. In order to resolve these problems, the following practices can be recommended, where these recommendations may help solve the different types of problems and are not specific to only one problem. The practices recommended are specific to post-hurricane scenarios wherein

1. In post-hurricane reconstruction projects, the uncertainty aspect of the project completion is higher than in other construction projects due to the psychological aspects of the affected community. Pre-hurricane planning, including preconstruction planning, use of building information modeling, optimum resource allocation and scheduling, is recommended for post-hurricane reconstruction projects. These will help reduce the problems faced with regards to site logistics and material transportation.
2. Due to the sudden nature of hurricanes, contractors generally involved in such projects must have plans regarding different resource allocation in place. These plans can be implemented as soon as the projects are given to contractors.
3. Implementation of supply chain management practices in the post-hurricane reconstruction industry can help eliminate the problems with material transportation. This will indirectly reduce the problem with site logistics by helping the contractors

to reduce prices by pre-stocking items which will have high prices due to future demand..

4. Outsourcing skilled labor is a good solution to labor problems. One of the practices that the contractors can implement is to use reliable sources in the region of construction, so that they could get the best skilled labor at low rates, due to partnering relationships with the trusted vendor.
5. One important consideration in post-hurricane situations is with regards to temporary housing, power and water supplies. A preconstruction survey becomes necessary in such scenarios to have a good plan about how to arrange the basics for accommodating the employees. Relocations must be properly planned for personnel who are being outsourced for post-hurricane reconstruction projects.
6. In a post-hurricane situation, there is a sudden increased call for labor, materials and supplies. This causes cost escalations, and strains company finances. Contractor firms should have sufficient potential to be immune to such impacts, by considering financial risk management options.
7. The most recommended project delivery systems in post-hurricane reconstruction projects are IDIQ and negotiated contracts because the scope in reconstruction projects is vast, and IDIQ helps to eliminate the risk of entering into a contract in reconstruction projects. Also, negotiated contracts reduce the time required to complete the bidding process involved in a design-bid-build process.
8. A general awareness of the problems and practices must be created about the post-hurricane project scenarios among the construction industry to be able to make the

business more profitable, by disseminating the knowledge in an organized manner. The presidents and CEOs must have adequate knowledge about such projects, and must initiate awareness among their employees. This will enable the problem solving process to begin at the preconstruction stages itself. These practices will benefit the construction industry, as a whole.

Significance of the study

Numerous hurricanes have struck the coastlines in the southeast region of the U.S.A. Even so, these areas experience a significant growth of population. Shorelines have always been popular locations for settlements. Since, people live there knowing the fact that there are possibilities of hurricanes striking their buildings down; the only other solution to the problem of hurricane destruction is by having a good post-hurricane recovery and rebuilding plan. For this, education, preparedness, and long term policy planning are effective measures to be able to recover faster (Blake et al., 2007). This proves that contractors will always be involved in construction activities in these hurricane prone areas. One of the ways to improve their efficiency and performance is to be aware of the problems in these areas and plan in advance to manage the problems better.

Though hurricanes have been studied and their effects have been documented, as also the problems faced in the construction industry have been studied separately by numerous researchers, this study's investigation combines the effects of hurricanes on reconstruction. It thus becomes necessary for the contractor firms to be aware of the problems that they may face after a hurricane in the reconstruction process.

The study concludes with a summary of findings and recommendations which prove significant to the contractors who are involved in post-hurricane reconstruction. This knowledge, when applied to the field, will help improve the ability of contractors to face the problems and deal with them in a more confident and experienced manner. Thus, this study indirectly benefits the owners of the project to get their projects done faster and more efficiently, using the most optimum resources efficiently as discussed in the summary of findings.

Recommendations for future studies

The study considers contractors' perception of the problems. However, one of the recommendations is to classify the contractors into small, medium and large type, and find the relation between their perceptions of problems in post-hurricane reconstruction. With a more reliable source of lists of contractors in reconstruction projects, this study can be repeated to see if there are any changes in the significance of some of the problems as major problems. This study lists the practices involved in post-hurricane reconstruction projects. Further these practices could be studied to see how much more profitable they are in terms of time, cost and quality.

A small percentage of responses could have limited the ability to infer from this study. Further studies could be performed to replicate the results of this study and this can be repeated using a higher number of contractors so as to get more responses.

In post-hurricane scenarios, insurance scopes and insurance delayed payments could be also another possible problem which makes reconstruction projects unfavorable as compared to new projects. This could be studied further in the future.

Considering a few complete post-hurricane reconstruction projects and their contract details, the effect of type of project delivery systems and its relations with duration of the project can be researched. These would help contractors decide the best kind of delivery systems for different problems. This study can further delve into researching how owners and architects might be influential in causing the reconstruction process to slow down.

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APPENDIX A

SAFFIR/ SIMPSON SCALE

(Simpson 1974)

Scale Number (Category)	Winds (Mph)	Typical characteristics of hurricanes by category (Millibars)	(Inches)	Surge (Feet)	Damage
1	74-95	> 979	> 28.91	4 to 5	Minimal
2	96-110	965-979	28.50-28.91	6 to 8	Moderate
3	111-130	945-964	27.91-28.47	9 to 12	Extensive
4	131-155	920-944	27.17-27.88	13 to 18	Extreme
5	> 155	< 920	< 27.17	> 18	Catastrophic

APPENDIX B

SURVEY OF CONTRACTORS INVOLVED IN POST-HURRICANE RECONSTRUCTION PROJECTS IN THE SOUTHEAST REGION OF THE UNITED STATES

Hello:
You are invited to participate in our survey. The purpose of this research is to identify the contemporary practices to overcome obstacles in commercial, post-hurricane construction projects in the southeastern region of U.S.A. that have been affected by hurricanes in the last ten years. This study will include 200 participants (contractors involved in post-hurricane reconstruction) and will take 10-15 minutes.

Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions.

Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact Suchayita (Sue) at 979-450-8955 or by email at the email address specified below.

Thank you very much for your time and support. Please start with the survey now by clicking on the **Continue** button below.

1. Has your company been involved with reconstruction projects after hurricanes in the past 10 years?
   - Yes
   - No
   - I do not know

2. What is your title within your company?

   ____

3. Please categorize the majority of your projects into any one of the following types based on monetary value. Please feel free to repeat the questionnaire if your company is involved in more than one size of projects.
    - Small: Less than $10 million
    - Medium: Between $10 million to $50 million
    - Large: More than $50 million projects

Based on a literature review, the following questions were developed to identify the type of problems faced in post-hurricane reconstruction projects and the practices used to solve them.
Your answers reflect the type of projects chosen in Q3.

4. a. Please rate how important the <u>site logistics</u> is considered as a problem on post-hurricane reconstruction projects.

1	2	3	4	5
Very low	Low	Medium	High	Very high

   b. If answered 4 or 5,
   Please describe the "best-practice approach" you used to solve this problem.

____
____
____

5. a. Please rate how important the <u>material transportation</u> is considered as a problem on post-hurricane reconstruction projects.

1	2	3	4	5
Very low	Low	Medium	High	Very high

   b. If answered 4 or 5,
   Please describe the "best-practice approach" you used to solve this problem.

____
____
____

6. a. Please rate how important the <u>labor supply</u> is considered as a problem on post-hurricane reconstruction projects.

1	2	3	4	5
Very low	Low	Medium	High	Very high

b. If answered 4 or 5,
Please describe the "best-practice approach" you used to solve this problem.

____

____

____

7. a. Please rate how important <u>getting building permits for different construction purposes</u> is considered as a problem on post-hurricane reconstruction projects.

1	2	3	4	5
Very low	Low	Medium	High	Very high

b. If answered 4 or 5,
Please describe the "best-practice approach" you used to solve this problem.

____

____

____

8. a. Please rate how important the <u>political influences in the hurricane affected area</u> is considered as a problem on post-hurricane reconstruction projects.

1	2	3	4	5
Very low	Low	Medium	High	Very high

b. If answered 4 or 5,
Please describe the "best-practice approach" you used to solve this problem.

____

____

____

9. a. Please rate how important the <u>site location (proximity to highways, wealthy or poor neighborhoods)</u> is considered as a problem on post-hurricane reconstruction projects.

1	2	3	4	5
Very low	Low	Medium	High	Very high

b. If answered 4 or 5,
Please describe the "best-practice approach" you used to solve this problem.

---

10. a. Please rate how important the <u>type of project delivery method used is</u> in post-hurricane reconstruction projects.

1	2	3	4	5
Very low	Low	Medium	High	Very high

b. If answered 4 or 5,
Please describe the "best-practice approach" you used to solve this problem.

---

11. Please rank each of the following items from 1 to 7. Put a "7" next to the item that is MOST problematic to you in a reconstruction project. Put a "1" next to the item that is LEAST problematic. Please use each number only ONCE

Unforeseen existing conditions	__
Scope changes by owner	__
Design change (upgrade)	__
Schedule problem	__
Design coordination	__
Regulatory requirements	__
Availability of labor & ease of hiring them	__

12. a. Apart from the problems mentioned above, please state three additional major problems faced by your company specific to post-hurricane reconstruction projects.
    1. ______________________________
    2. ______________________________
    3. ______________________________

    b. What steps did you use or could you have used in order to solve any of the above mentioned problems?

    ____
    ____
    ____

13. a. Are there any clauses in the contracts or government policies that you think could help change the outlook towards reconstruction processes?

    ____
    ____
    ____

    b. Please mention them if you think there are any.

    ____
    ____
    ____

14. a. Is there anything about post-hurricane reconstruction that we have not asked you that you believe is important and should be mentioned here?

    ____
    ____
    ____

    b. If so, please describe, what you believe is important and is required to be known by the construction industry.

    ____
    ____
    ____

15. If you would like the results of the report to be emailed to you, please type in your email id. ______________________________

Thank you very much for completing the survey. Your response truly matters a lot for this research survey.
The data collected will be analyzed using statistical tools and the results will be used for my thesis “Investigation of Contemporary Practices in Post-hurricane Reconstruction in the Commercial Sector of the Southeast Region of U.S.A”.
Thank you once again for your cooperation.
A summary of findings will be presented to each of the participants at the end of the research project. Please include your preferred method of contact to send you the results of the project.

Please contact me if you have any questions or suggestions- suchayita@tamu.edu

APPENDIX C

RESPONSES TO THE OPEN-ENDED QUESTIONS

<u>Site Logistics</u>

1. Better Planning
2. Planning in advance
3. Language
4. Supply chain management, but hurricanes increase uncertainty of everything
5. Taught hispanics to speak
6. good project manager who solves problems well
7. Just in time concepts
8. Planning
9. Onsite labor mgmt
10. planning with all subcontractors in meetings before start of the project
11. “Pre-disaster analytics used to prepare staging of materials, resources and communications.”
12. “selecting materials for the repairs that aren't on the list of others.”
13. Use of on-site labour
14. labor mgmt
15. Proactive, planning well in advance
16. site personnel with experience
17. Coordination
18. Best Practices

19. site planning done well before project with entrances, exits in mind by PM
20. experience superintendents
21. Planned strategy depending on project
22. Planning
23. Site layout plans made before mobilization
24. Good coordination
25. “Design, on-site labor management and transportation management are key issues that need to addressed on solve the logistics issues”
26. “This is totally dependent upon the location of the damage, but in general, the lead members of the reconstruciotn team must coordinate to the greatest extent posible with the owner of the property, the AHJ, local law enforcement agencies, military personnel, local utility companies, etc. before stepping off too deep into a plan.”
27. “Space Scheduling”
28. “Preconstruction Planning”
29. “Good co-ordination between team members.”
30. “Risk Management Research and Development”
31. “Time sensitive and aggresive procurement”
32. Preplanning
33. Language learning essential
34. Planning scheduling
35. BIM

36. Use of precast items so that stocking on site is less
37. Communication
38. Use of good supply chain management. Usually expensive, so not done always…
39. Optimum resource allocation
40. "Make sure FEMA representative are present at all site visits to survey damages and come agreements in the field about needed rpairs"
41. "Provision of more reliable transportation infra-structure."
42. "Qualified trades men were sourced by using regional vendors for each trade when local resources were either not available or over priced. Additional safety professionals and oversite was needed to ensure an incident and injury free job site. we worked with a local university to provide ESL classes on site to improve communication with the hispanic workforce."
43. "location dependent,good coordination"
44. "Planning before mobilization"

Material Transportation

1. incentives to vendors for ontime delivery
2. conventional method followed, no other option
3. good relationships with vendors, suppliers
4. ordering well in advance
5. Planning early
6. good planning
7. partnering

8. plan and more plan
9. “Having the scope of work understood by everying team member and especially to the procurement team will help us understand the transport management on job-sites.”
10. “partner w/ companys ahead of time”
11. “This goes hand in hand with logisitcs. Ideally, a company has placed an order or already bought essentials like plywood, drywall materials, glass, etc. prior to immediately after a storm. Temporary chillers, very high capacity water pumps, etc. are critical to obtain. If they have offices around the nation like we do, they can acquire materials out of town of out of state and ship or truck them in.”
12. “Space Scheduling”
13. “Good logistics services”
14. “Pre-ordering of essentials immediately after a storm.”
15. “Supply Chain Management”
16. Preplanning
17. partnering
18. “many contractors increased prices well above normal due material and labor shortages”
19. “stocking after disasters”
20. “Good logistical analysis”
21. “In preparing for hurricanes on the Gulf Coast we have staged pre-cut plywood near all of what we have identified as high risk locations. This will be installed

on the building once the danger of a hurricane has become highly likely. We have strategically staged generators all along the Gulf Coast. These will be dispactched to a store in the event of a power loss. All the stores have a quick connect on the back of the stores for the generators. A team of disastor recovery managers will be dispatched to the area. These teams will be bringing essential material such as water, gas, first aid equiptment,,,,etc"

Labor

1. use of outsourced skilled labor
2. supply chain mgmt helps solve this
3. local labor sufficient
4. labor available due to people losing jobs
5. local labor available plenty
6. Partnering with old vendors and suppliers
7. "Pre-hurricane relationships"
8. "Identify additional sources of labor and lodging available to house the labor force."
9. "Bring in our own crews."
10. "Engage national (large) contractors to help with the recovery and reconstruction so they bring in their own trained crews."
11. labor supply aplenty because lot of people willing to work in hurricane struck area.
12. labor cheap

13. easy availability of labor, though not skilled..basics taught on site
14. lot of locals used as labor
15. hiring local labor
16. “Outsourcing”
17. skilled labor from hurricane unaffected areas
18. labor bought from other areas
19. skilled labor from other areas brought to site
20. Provision of living amenities, so that labor does not have to travel too much.Area damaged,so finding homes of labor very difficult.
21. “Understanding the demand supply chain in the regions and the work to be performed and understanding the labor requirements are key.”
22. "have a team already set before a problem"
23. “Same as above. this is probably the most critical part. Without labor, you cannot do much at all.”
24. “differences in communities willing to work. Local labor or cheap labor.. choosing the best skilled labor from a truted and reliable source”
25. “Outsourcing labor.”
26. “Supply Chain Management”
27. “Get Local labor, if available”
28. “outsourcing skilled labor”
29. labor brought in from surrounding areas where hurricane has not caused damage

30. good relationships with subcontractors help tackle labor problems because they can bring in labor
31. Prepared team ready for assistance
32. outsourcing labor from unaffected areas
33. “Use of regional vendors versus local only.”
34. Choose skilled labor from trusted source.
35. “many contractors increased labor prices well above normal due to a lack of housing for labor force. Most labor end up driving great distance.”
36. “have a team already set before a problem”
37. “Bring in from outside the area.”
38. “We bring in managers and labor from othe regions within our area that have not been impactaed by the storm. we also have security guard companies, enviromental companes and various other vendors on retainers that will provide us priority service when needed.”

<u>Building permits</u>

1. Sometimes, it's not a problem because rebuilding is important, so it's fast,else experience of contractor in locality boosts speed of approvals
2. “Getting permits are a lengthy process”
3. “Planning”
4. “Rebuilding is a priority for everyone, hence getting a permit isnt a problem.”
5. “LEED certification prerequisites satisfied”
6. Use of photographic records for inspectors to check

7. Matter of experience
8. "timely inspections are impossible.establishing photo record keeping that is acceptable to inspectors if possible helps."

Political influences

1. pol infl help get permits faster
2. “Communicate, communicate, communicate.”
3. political influences help if damage is in their region
4. strong leadership in local body helpful
5. healthy politics helps boost recovery faster
6. “For building permits issue, its not an issue to be addressed in catastrophy effected regions, because re-building is more important and in fast tract. Infact we get more support from political influences to get the permits quicker.”
7. “This is when the constiuent's relationship with their congressman comes in play. It also helps when the president hails from the state where the damage occurs. The pportunities begin when the damaged area is governed with strong leadership such as the mayor, governor, etc.”
8. “Starting the process of getting permits early in the project”
9. “Ability to have a proper representation for contractors at the local level.”
10. “Try to keep a low profile.”
11. strong leadership

Site location

1. pre constr survey
2. “Understanding the post-hurrican situation and strategically locating your site-office with required security is important.”
3. “This relates to the proximity to the main thoroughfare. If you must travel a great distance or if the roads are damaged, then relief must be airlifted in. Military assistance is best.”
4. “Pre construction survey”
5. “Making the site accessible in the worst scenario is absolutely essential, hence the transportation system has to be fool proof.”
6. “Building by-laws”
7. understanding post hurricane scene in area affected
8. high security in area of construction
9. use of trusted security services
10. “power restoration to high end housing areas and the CBD appear to have top priority”
11. “North shore location selected not only for storm protection but motivation of local community to embrace the project. Also provided a safe enviroment for employees and good schools.”
12. “Locating site office carefully, understanding economic scenario of hurricane affected area”

Project delivery systems

1. negotiated contracts
2. negotiated contracts
3. IDIQ
4. “Negotiated contracts”
5. “What the hell is a project delivery system?”
6. “Online delivery.”
7. Best
8. “Use of crane equipped marine barges with access and work being performed over the water.”
9. “Conventional A/E investigation and design. Negotiate with contractors. A/E observes construction and documents post remediation verification.”
10. negotiated contracts
11. IDIQ
12. IDIQ
13. negotiated contracts
14. cost+fixed fee
15. cost+fixed fee
16. “IDIQ is the most viable solution for sharing the risk and making subs and GC's understand the no-scope concept.”
17. “truck”

18. “Cost plus a fixed fee that is completely auditable. Materials, labor, equipment, everything must have a good paper trail. The guidelines for accounting and payment applicaitons must be established as early in the process as possible.”
19. “ID IQ”
20. “IDIQ method ensures profit”
21. “Cost plus a fixed rate”
22. “Design Build”
23. “Design Build and cost plus.”
24. cost+fixed fee
25. negotiated contracts
26. “pay per task or wtvr... i hav so totally forgotten wat that;s called... definitely not lumpsome...”
27. “CMA, DBB”
28. “Because of resource availability issues the delivery method needs to allow for flexibility to leverage regional vendors and relationships.”
29. “IDIQ and negotiated contracts”
30. “anyway any how”
31. “Time and Material”

<u>Unmentioned items related to problems</u>

1. “Availability of supplies

   Insurance scopes (what is covered)

   Insurance delayed payments”

2. “Cash flow and working capital. The suddenly increased call for labor and materials and supplies being higher in demand drives up costs and strains the company finances.”
3. Hike in prices
4. “Material availability locally, good places to live for the employees, neighborhood.”
5. "Local area condition
   Enviromental condition
   Working condition"
6. ”Organizing workers and employees to assist in the effort while their own homes were damaged.
   Having time to rest.
   Ensuring everyone received a b-12 shot.”
7. “Site office location, Security problem, Good places to stay for the employees.”
8. “De-watering the site, demolition and disposal.”
9. demoltion, insurance, place to stay for employees
10. “1-temp housing
    2-temp power
    3-temp building supply warehouses”
11. “Cost escalation
    Employee relocations”
12. “Insurance”

Practices used to solve unmentioned problems

1. “More firearms”
2. “try your best, no generic solutions can you used to slove them.”
3. “Ease of regulatory requirements in post-storm situations.”
4. “As an architect with the state the contractor's had to resolve these problems. the state did lift the weight limit on trucks. which helpped some.”
5. “Optimal utilization of technology in allied fields of construction.”
6. “Use of regional vendors and national accounts for products provided relocation assistance and benefit packages”

Contract clauses or policy recommendations

1. “payment methodology should change. Pay the sub when you get paid will not work in these situations.”
2. “Contractors should be aware that FEMA loves to have things bid several different ways before they allow construction to be start.”

APPENDIX D

RESPONSES TO THE CLOSED-ENDED QUESTIONS

Response no.	Title	Proj size	Site logistics	Material transportation	Labor	Building permits	Political influence	Site location	Proj delivery system
1	Sales Manager	1	4	3	4	3	2	2	4
2	PE	1	5	2	3	2	2	3	1
3	PE	1	4	2	3	2	2	2	4
4	Proj Exec	1	4	1	4	1	4	3	3
5	Sales Dir.	1	5	4	3	3	1	3	5
6	Owner	1	2	5	4	3	3	2	3
7	Exec. VP	1	4	5	3	4	4	2	3
8	Proj Exec	1	2	3	5	2	3	2	2
9	Proj Exec	1	4	4	4	2	3	3	5
10	CEO	1	5	4	5	2	3	3	5
11	Purchasing/Estimating	1	2	2	4	3	3	2	3
12	Owner	1	4	4	4	2	5	2	2
13	Orion Construction LP	1	2	4	4	2	3	3	4
14	President	1	4	3	5	3	5	3	1
15	VP Estimating	2	5	4	5	3	4	3	3
16	Asst. PM	2	4	5	4	3	5	4	4
17	Exec. VP	2	4	5	5	5	3	3	4
18	PM	2	5	5	5	3	3	2	5
19	Senior PE	2	4	4	3	4	4	1	3
20	PM	2	4	4	5	3	4	3	5
21	Asst. PM	2	5	5	5	2	3	3	4
22	PE	2	5	4	5	3	4	1	5
23	PE	2	4	5	5	3	2	3	3
24	Asst. PM	2	4	5	4	3	3	3	4
25	PM	2	4	4	5	3	4	3	1
26	Architectural Associate	2	4	4	5	3	4	5	4
27	HR Generalist	2	4	4	4	3	3	3	3
28	Assistant Vice Presider	2	4	4	4	2	4	4	5
29	Project Engineer	2	4	4	3	5	3	5	3

Response no.	Title	Proj size	Site logistics	Material transportation	Labor	Building permits	Political influence	Site location	Proj delivery system
30	Vice President	2	4	4	4	4	4	3	4
31	Project Manager	2	4	5	4	5	4	5	5
32	Project Engneer	2	4	4	4	4	3	4	4
33	Project Engineer	2	5	3	4	4	5	5	4
34	.	2	4	4	4	3	3	5	3
35	PM	3	5	2	5	2	1	3	5
36	Senior PM	3	5	4	5	5	3	5	4
37	Sales Dir.	3	5	4	4	3	3	4	3
38	VP Estimating	3	4	4	5	4	3	4	3
39	PM	3	1	2	3	2	1	3	2
40	Division Sales Officer	3	5	4	4	3	2	4	3
41	Chairman	3	4	5	4	4	2	4	3
42	Senior PE	3	5	4	5	3	5	2	2
43	Area Manager	3	4	5	5	3	2	3	4
44	VP National Sales	3	5	4	5	5	3	3	3
45	project manger archite	3	5	4	5	5	1	4	3
46	Regional Vice Presider	3	4	4	4	3	3	4	3
47	Graduate Engineer	3	4	3	3	3	3	3	3
48	Project Engineer	3	4	4	4	3	4	3	2
49	Project Manager	3	5	3	5	3	3	5	4
50	VP	3	5	4	4	3	3	3	4
51	Senior Project Manage	3	4	4	5	3	2	4	4

Response no.	Unforeseen conditions	Scope changes	Design change(upgrade)	Schedule problem	Design coordination	Regulatory requirements	Availability of labor
1	3	5	4	1	2	6	7
2	6	3	2	4	1	5	7
3	3	4	5	6	1	2	7
4	6	7	1	5	2	3	4
5	3	5	4	1	2	6	7
6	3	4	6	1	2	7	5
7	6	3	2	4	1	5	7
8	7	2	3	5	1	4	6
9	3	4	5	6	1	2	7
10	3	4	5	6	1	2	7
11	6	3	2	4	1	5	7
12	6	7	1	5	2	3	4
13	3	4	6	1	2	7	5
14	3	4	5	6	1	2	7
15	7	6	3	5	2	1	4
16	5	3	2	4	1	6	7
17	7	6	3	5	2	1	4
18	5	3	2	4	1	6	7
19	4	3	2	5	1	7	6
20	5	7	4	1	3	2	6
21	7	1	5	3	2	4	6
22	1	6	2	3	5	4	7
23	3	1	4	7	5	2	6
24	5	3	2	4	1	6	7
25	6	5	3	4	1	2	7
26	5	7	4	1	3	2	6
27	7	6	3	5	2	1	4
28	3	1	4	7	5	2	6
29	1	6	2	3	5	4	7

Response no.	Unforeseen conditions	Scope changes	Design change(upgrade)	Schedule problem	Design coordination	Regulatory requirements	Availability of labor
30	5	3	2	4	1	6	7
31	7	1	5	3	2	4	6
32	1	4	2	3	5	7	6
33	5	3	2	6	7	1	4
34	7	3	4	2	1	5	6
35	2	1	3	6	4	5	7
36	2	5	4	7	6	3	1
37	1	2	7	3	4	5	6
38	3	2	1	5	4	6	7
39	5	2	3	6	1	4	7
40	6	1	2	4	3	5	7
41	1	2	7	3	4	5	6
42	2	1	3	6	4	5	7
43	5	2	3	6	1	4	7
44	3	2	1	5	4	6	7
45	1	4	2	6	5	3	7
46	6	1	2	4	3	5	7
47	1	2	7	3	4	5	6
48	2	5	4	7	6	3	1
49	5	2	3	6	1	4	7
50	5	3	2	6	1	4	7
51	6	2	1	4	5	3	7

APPENDIX E

IRB APPROVALS

TEXAS A&M UNIVERSITY
DIVISION OF RESEARCH AND GRADUATE STUDIES - OFFICE OF RESEARCH COMPLIANCE

1186 TAMU, General Services Complex
College Station, TX 77843-1186
750 Agronomy Road, #3500

979.458.1467
FAX 979.862.3176
http://researchcompliance.tamu.edu

Institutional Biosafety Committee | Institutional Animal Care and Use Committee | Institutional Review Board

DATE:	11-Jun-2008
MEMORANDUM	
TO:	BHATTACHARJEE, SUCHAYITA S 77843-3578
FROM:	Office of Research Compliance Institutional Review Board
SUBJECT:	Initial Review

Protocol Number:	2008-0316
Title:	Investigation of Contemporary Practices in Post-Hurricane Reconstruction in the Commercial Sector of the Southeast Region of the U.S.A.
Review Category:	Exempt from IRB Review

It has been determined that the referenced protocol application meets the criteria for exemption and no further review is required. However, any amendment or modification to the protocol must be reported to the IRB and reviewed before being implemented to ensure the protocol still meets the criteria for exemption.

This determination was based on the following Code of Federal Regulations:
(http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.htm)

45 CFR 46.101(b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior, unless: (a) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (b) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Provisions:

This electronic document provides notification of the review results by the Institutional Review Board.

TEXAS A&M UNIVERSITY
DIVISION OF RESEARCH AND GRADUATE STUDIES - OFFICE OF RESEARCH COMPLIANCE

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Institutional Biosafety Committee | Institutional Animal Care and Use Committee | Institutional Review Board

DATE: 11-Jul-2008

MEMORANDUM

TO: BHATTACHARJEE, SUCHAYITA S
77843-3578

FROM: Office of Research Compliance
Institutional Review Board

SUBJECT: Amendment

Protocol Number:	2008-0316
Title:	Investigation of Contemporary Practices in Post-Hurricane Reconstruction in the Commercial Sector of the Southeast Region of the U.S.A.
Review Category:	Exempt from IRB Review

It has been determined that the referenced protocol application meets the criteria for exemption and no further review is required. However, any amendment or modification to the protocol must be reported to the IRB and reviewed before being implemented to ensure the protocol still meets the criteria for exemption.

This determination was based on the following Code of Federal Regulations:
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45 CFR 46.101(b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior, unless: (a) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (b) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Provisions: Modifications to information sheet and questionnaire.

This electronic document provides notification of the review results by the Institutional Review Board.

VITA

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